FLOW WRAP PACKAGING: THE MOST WITH THE LEAST

High protection, low impact

Edited by Beatrice Lerma and Doriana Dal Palù
based on the intuition of Riccardo Cavanna

Edizioni Ambiente

Flow wrap packaging: the most with the least

High protection, low impact

Dedicated to Sam Campbell, Mario Pavesi, Mario Cavanna, and all the visionary pioneers who weren't able to read this story, but are a part of it.

Flow wrap packaging: the most with the least
High protection, low impact

Edited by
Beatrice Lerma and Doriana Dal Palù
based on the intuition of Riccardo Cavanna

Politecnico di Torino
1859
Department of Architecture and Design

Working group of the Politecnico di Torino, DAD - Department of Architecture and Design:
Beatrice Lerma
Doriana Dal Palù
Ottavia Burello

Translator: Transitus Group S.r.l., Bastia Umbra (PG), Italy.

Cover image courtesy of photographer Luca Artioli.

via privata Giovanni Bensi 12/5, 20152 Milano
www.edizioniambiente.it
tel. 02.45487277

White Paper published in May 2022

ISBN 978-88-6627-358-5

Printed in May 2022
at GECA srl, San Giuliano Milanese (Milan), Italy

Printed in Italy

FLOW WRAP PACKAGING: THE MOST WITH THE LEAST

High protection, low impact

Edited by Beatrice Lerma and Doriana Dal Palù
based on the intuition of Riccardo Cavanna

Edizioni
Ambiente

Table of contents

Flowpack – A Wonderful Packaging Solution

by **Jim Pittas**, President and CEO, PMMI, The Association for Packaging and Processing Technologies[1]

Hello to the Packaging Community,

It is incredible to consider that PMMI member companies have been providing flowpack solutions for over a century. During that time, dozens of companies, like PMMI founding member Package Machinery Corp. in the early 1900s, Campbell Wrapper with its U.S. patent application for a flow wrapper in 1946, plus Doboy (originally Doughboy) and Hayssen Manufacturing Company became industry-leading names. Six flow wrapper manufacturers exhibited at the first packaging machinery show organized by PMMI in 1956 in Cleveland, Ohio (USA). Just four shows later, 19 wrapper companies exhibited, including some of the first European companies to exhibit in the U.S. These and many additional innovative manufacturers provided solution sets throughout the 1900s, driving the success of flow wrapping in an increasingly sophisticated packaging environment.

It is important to remember that every consumer brand mandates that packaging solutions meet a broad range of needs:

- promote the product inside the packaging;
- protect the product;
- support the product through the transportation system;
- provide information on proper use as well as ingredients.

Ultimately, the demanding requirement for all packaging types is to deliver an excellent, safe product for purchase and use by the consumer. We are all consumers of packaged products in packages, and all of us realize that consumers want products protected to the total value of the product right to the point of use. It is a credit to the industry and its people that national and international machinery producers continue to adapt to handle 21st-century business demands, including increasingly vital sustainability metrics, increased production efficiency, and multiple degrees of automation to match each customer's market and company objectives.

This past decade (2010-2020), the dramatic increase in e-Commerce added a further layer of complexity that impacted the entire packaging value chain. A flowpack solution remains

1 Thanks to Tom Egan (Vice President of Industry Services for PMMI, the Association for Packaging and Processing Technologies) for the support.

an excellent option to navigate this additional challenge, allowing producers to provide combinations of products such as flavors, each in their own packaging.

Flowpacks still protect each individual product and the consumer benefits because multiple products at the right quantity reach their doorstep. The brand owner producing the product benefits through the ability to meet consumers' needs at the amount and location the consumer desires.

I invite you to reflect on these 100-plus years of advancements and the many companies and thousands of teams that made it happen. It is not surprising – indeed, it is expected – that packaging solutions providers for both the machinery and materials side must continue to collaborate closely in offering a robust and adaptable solution. It is also important to remember that the solution set involving flowpacks can apply to food, apparel, pharmaceuticals, dental products like Fuji Foremost's 2003 dental film application, small consumer products, and thousands of personal care products. In summary, a flowpack is a solution for numerous consumer products throughout all market segments of the packaging value chain.

Congratulations to the team assembling this research on flowpack for delivering an outstanding result.

We hope all who use this valuable reference, whether consumer or professional, will learn something new about packaging. We anticipate that each reader will better appreciate the role of the flowpack and the great future that flowpacks hold in the 2020s and beyond.

Some more references about auto wrappers and packaging machinery are available here:
http://www.autowrappers.co.uk/history-3.htm
http://www.packagemachinery.com/package_machinery_-_about-us/package-machinery-a-history-of-wrapping-machines/


ownership, your choice will be
Cavanna Packaging Group

The extraordinary history of "packaging with wings"

by **Riccardo Cavanna**, incoming President of the Unione Costruttori Italiani Macchine Automatiche per il Confezionamento e l'Imballaggio (UCIMA – Italian Automated Packaging Machine Manufacturers' Union) for the 2022-2024 period

This paper is the product of the desire to recount the extraordinary history of "packaging with wings", which has seen generations of entrepreneurs and innovators – first in the US and later in Europe – work together, helping to make it the most popular and democratic packaging in the world.

But it is precisely within this world-leading supply chain that we realised there is a profound difference in the perception of the future, in terms of sustainability. The culture of functionality and of the importance of packaging is lacking in general, but so too is awareness of the opportunities offered by technology in promoting a genuinely circular economy. If we look at the seas of plastic and their powerful effect on the collective imagination, we need to ask ourselves whether the blame truly lies with plastics alone, or whether this ecological disaster should actually be attributed to a dysfunctional circular economy, but above all, to poor consumer education. We must not be influenced by the suggestive images, but rather understand where we are currently at with packaging technology, and how we got here, measuring actual sustainability through science and methods such as the Life Cycle Assessment (LCA).

This White Paper, which aims to disseminate historical, scientific, and cultural knowledge, seeks to bring the world of the circular economy closer to that of policy makers and new generations, capable of influencing future consumer trends. To avoid there being more flow wrap packaging than fish in our seas, we need to be world leaders, not only in the packaging sector (where Italy is already at the forefront), but also by stimulating and exporting a supply chain development model for a genuinely circular economy.

Happy travels to those who will read, perhaps as we did too, from the bottom up, starting from how recycling plants work all the way to polymer, along the wonderful journey through the world of packaging.

Past, present, and future of flexible packaging

by **Alberto Palaveri**, President of the GIFLEX (National Association for Flexible Packaging - Assografici, the Italian Printing and Paper Converting Industries Association) for the 2021-2023 period

Flexible packaging was inspired by the idea to produce protective, light, resistant, and safe wrapping to preserve food and non-food products.

Over the years, in response to rapidly changing market demands and consumer needs, member companies of GIFLEX (National Association for Flexible Packaging – Assografici, the Italian Printing and Paper Converting Industries Association) have developed increasingly sophisticated and efficient technological-material innovations.

Today, however, we find ourselves facing challenges of high social relevance and impact: from the fight against *Climate Change* to that against *Food Waste*, from ecological transition to the recyclability of our materials.

For some of these issues, flexible packaging is in itself a great ally.

It is light. Flexible packaging represents 50% of the packaging materials on shelves, but only 15% of the total weight of packaging materials used. Thanks to its lightness and energy-efficient production processes, very little CO_2 is generated.

It reduces food waste. Flexible packaging extends the life of food even hundreds of times over its natural decay cycle. Moreover, it allows portioning, preservation, guarantees food hygiene and safety.

And for those still unresolved challenges, thanks to continuous Research & Development on innovative materials, as well as strong industry collaborations – of which this paper is a perfect example – flexible packaging is set to master the delicate stage of ecological transition, overcoming the challenge of recyclability: a second life for used materials to promote and protect their contents and value.

The historical-technical-scientific analysis presented in this paper helps to explore and raise awareness regarding the value of flexible packaging, to understand where it all began, and to prepare ourselves for the near future.

Preserves, transports, and sells 60 times its weight

The magic of flow wrapping, the world's most widespread and innovative packaging for more than 80 years, produced with automated machinery

by **Luca Maria De Nardo**, packaging journalist

I found myself in Paris visiting the Salon de l'Emballage (that's how it used to be called, its name has since changed), on an autumn day many years ago.

I normally use my trips as an opportunity to visit the local shopping centres: In Paris, for example, the hypermarkets of the various chains, luxury stores such as Fauchon, and large specialised department stores of the calibre of Le Bon Marché... That year, however, I was persuaded otherwise by a colleague's suggestion and ended up spending my free day at the Musée du quai Branly under the Tour Eiffel.

At the entrance, I was welcomed by an impressive reconstruction of a dry riverbed. The bas-reliefs sculpted into the synthetic material along the walls illustrated the interaction between various human cultures and our land with the aim of inhabiting it, using it, living it: they represented the different types of settlements. This immense riverbed was used as a means of connecting the various sections of the museum, each dedicated to a different continent.

I became fascinated by the colours and textures of the Siberian Shamans' ritual vestments, so beautiful as to evoke the art of Missoni, but 500 years prior. In the halls dedicated to China, a showcase illustrated how a vegetable fibre was used in antiquity to obtain cups and bowls with resistance and elegance matched only by the most expensive porcelain, using complex and slow progressive processes. The explanatory panels described how China was defined as a civilisation based on its use of vegetable fibres in all their forms and structures, thanks to ancient technological knowledge.

After four hours of visiting, I had barely seen two continents. In the bookshop at the exit, my gaze fell on a small publication dedicated to Japanese Furoshiki: the medieval art of creating dozens of different wrappings (baby carriers, gift wrappings, pouches to carry lunches to men working the fields, etc.). An art recently rediscovered by a number of Japanese luxury chains and currently proposed as an alternative to luxury shopping bags in fine paper with rope handles.

I often find myself needing to explain to non-experts the basis of my work, and many remain disoriented, amazed, perplexed at the level of interest and emphasis on a service element as ephemeral and quotidian as packaging. I usually start 'ab ovo', explaining how life effectively

begins with the most beautiful and complex packaging ever created by nature: the amniotic sac, a masterpiece of bioengineering which for nine months preserves, protects, nourishes and promotes the human being's development with a natural shockproof water bubble. A high-performance membrane: the possibility of artificially rebuilding it in a lab? The NASA Shuttle project would cost less.

Even after the waters break, the packaging stays with us. Once in the world, our source of nourishment is guaranteed by a second high-performance biological packaging: the mammary glands, equipped with a smart dispenser; in mammals, the nipple is comparable to the artificial silicone membranes used to release liquid foodstuff when pressure is exerted on their outer walls, in a squeezing motion, while preventing external liquids from rising back up to avoid bacterial contamination of the liquid inside. This is exactly what happens in the mammary glands, which rarely become inflamed due to infections of external origin; all artificial membranes, from feeding bottles to the smart caps of 'squeezable' bottles and flasks, imitate this mechanism.

In short, without going so far as the latest type in wood, packaging effectively has a much greater impact on our daily lives than one might imagine. There's nothing modern about it: for centuries, the marshy subsoil of Milan was drained by the Romans using not only artificial channels, but also packaging waste: end-of-life amphorae buried neck down, but also fragments of amphorae to consolidate the soil. We have the Romans to thank for the first disposable consumer packaging, with which they 'marked' Europe, Africa, and Asia.

Whether an emptied out pumpkin, a skin flask, or Phrynium leaves still used in Vietnam to wrap and preserve foods for long periods, the need for preservation and transport is eternal. The scientific name for those Asian leaves is... Stachyphrynium placentarium! A blatant connection with the theme of birth!

Without needing to travel for 12 thousand kilometres, however, suffice it to visit Val Seriana, where the meat rolls are 'stewed' in a pot wrapped in cabbage leaves, not aluminium. Or Cilento, where figs are wrapped in fig leaves and baked in the oven. From parchment paper to parchment leaf!

Packaging is a cultural expression, transversal to geographical space and historical time. It is above all an irrepressible instinct, because unlike most living species, mankind needs to secure – throughout space and time – a constant supply of food, drink, tools, detergents, medicines, and cosmetics. And he needs to trade them, an act foreign to all other living forms.

"No packaging" is a slogan of protest, not a perspective. History is not rewritten, it is improved. More often than not, it is during the most dramatic and bloody moments of human history, during war, that new inventions arise and applications are developed. Like Frenchman Nicolas Appert's discovery of the possibility to inhibit the spread of bacteria by cooking in glass containers, which became the basis for the birth of long-life foods, preserved by heating in airtight containers. His method was applied by Pierre Durand, who patented the system but using tin containers, later replaced by tinplate. The first to benefit from this new system were the soldiers of the Napoleonic conquests.

Another innovation that came about as a consequence of war, in this case the Second World War, is precisely flow wrapping. However, it is not the only packaging to have enjoyed stellar status following a war: the now irreplaceable wooden pallet was also developed in those

years in response to practical needs, and similarly spread throughout Europe. The pallet is now indispensable for modern-day logistics, just as flow wrap packaging is for primary consumer goods: invented just a few years before the start of the war, its development was significantly boosted by the pressing need to supply fresh, clean crackers to the troops. And today, it is the second most popular 'engineered' packaging in the world after the pallet.

But unlike the pallet, flow wrap packaging boasts a higher engineering content. Its formation can be likened to the complexity of in-flight refuelling from one aircraft to another, or the process of aligning the Mir space station with the Shuttle. Using a single flexible material, a tubular shape is created in a fraction of a second before the products, be they regular or irregular, enter the 'tube'. It all happens in the blink of an eye: as the moving film is fed, the flaps are already aligned, overlapped, joined, sealed, and all separated from the rest of the film which is yet to assume the tubular shape for the next flow wrap packaging. The art of flow wrapping is the art of high-speed joining and alignment.

An old 1956 advertisement for the new Nabisco Motta Crackers Premium showed a baker's apprentice taking a cardboard box out of a wicker basket, traditionally used to deliver fresh bread to people's homes, handing it to a woman standing at the doorway. A little over ten years had passed since the end of the war, and everything was changing. The year 1957 is symbolically remembered as the birth of the supermarket in Italy (the first Esselunga in viale Regina Giovanna in Milan), a form of trade based on self-service and which required packaged products. In Italy, just like in Europe and the rest of the world, dozens and dozens of new automation machine manufacturers popped up, and those that already existed were expanded even further; manufacturers of flow wrap packaging were all founded and developed precisely during those years.

A generator of new products, brands, companies, and innovative materials, the success of flow wrap packaging is also shared by consumers: in addition to the practicality of single-serves and the possibility to create multipacks, they are also easy to open. Teaching a child how to open multi- and single-serve flow wrapping is easy: you use the thumb and index finger of both hands and pull like you would a rubber band; alternatively it can be torn like a sheet of paper. If zig-zag cut lines are inserted, they become an invitation to tear and facilitate the task, which is even simpler when a tear strip is applied for tearing to the right. These are now instinctive sequences in all forms and configurations, yet another aspect helping to characterize flow wrapping as the most popular and widespread form of packaging.

Then, just like now, flow wrap packaging offers the best ratio between the weight of the packaging and weight of the contents, the performance being equal. A simple pack of crackers: 36.75 grams of product in 0.60 grams of wrapping. Unrivalled performance, even for Mother Nature. For new products, one can only hope they can be flow wrapped: because there is no technology that costs less, impacts less, but offers so many advantages.

A balance between content protection and environmental impact

by **Beatrice Lerma** and **Doriana Dal Palù**, Assistant Professors in Design, DAD – Department of Architecture and Design, Politecnico di Torino

This document is the first result of research activities that aim to investigate, in a broad sense, the relationships between Flow Wrap Packaging and Sustainability.

The study and analysis, also through the most important milestones of flexible packaging, flow wrap packaging, and patents insofar as "objective historical testimonies" (Giedion, 1948), of the material-technological-cultural challenges and innovations of the past, present, and future, creates, in a complex and multidisciplinary framework, the vision of a flexible but democratic packaging, supported by a wealth of highly complex technology, and a broad spectrum of future challenges. Flow wrap packaging addresses issues such as the extended shelf life of the packaged product strictly connected to the theme of *food safety* and *food security*, as well as *healthy food*, but also issues regarding inclusion and accessibility – sometimes in extreme conditions – of both food and non-food products: suffice it to think of food or medicines now increasingly "on the move", but also the efficiency of materials and reduction of waste, contents, and packaging.

The study investigates the role, in the production and design sector, in society, and in consumption, from past to future, of flow wrap packaging, a type of packaging that well represents the flexible packaging sector, characterised by extreme lightness with respect to the product it protects, and which is converted, with the industrialisation of the traditional product, into a *"sophisticated communicative artefact, which adopts visual rhetoric tools to promote the easy and fast consumption of goods"* (Bassi, 2015).

This paper seeks to present and summarise the key stages in the evolution of this packaging, the current and future challenges, strictly linked to the innovations and inventions of production materials and technologies, but also new ways of containing and selling, of consuming and communicating, today increasingly geared towards sustainable recyclable and/or compostable solutions.

From the research question to the White Paper

This research project dedicated to the world of packaging materials and manufacturing companies in both this sector and others, is a response to the desire to shed light on the

connections between the aforementioned themes, and to respond to the great question, "Is there a future for flow wrap packaging?" raised by Dr. Riccardo Cavanna, incoming President of the Unione Costruttori Italiani Macchine Automatiche per il Confezionamento e l'Imballaggio (UCIMA – Italian Automated Packaging Machine Manufacturers' Union) for the 2022-2024 period.

The study was conducted by a Design research unit of the Politecnico di Torino, but in continuous contact and discussion with the numerous national and international parties involved, ranging from trade associations to key institutions representing the packaging sector, and even companies themselves involved in all stages of the supply chain, from the production of film to its disposal. The research sector was also involved through universities and their researchers who offer a scientific insight to the most recent evolutions of flow wrap packaging. The findings were then collated and made available to a broader public through the drafting of this publication, a White Paper designed to generate culture on the theme of flow wrap packaging.

The decision to compose the results of this study in the form of a White Paper rather than present them as a scientific article or monograph, was both strategic and connotative. In particular, the original concept of the White Paper was conceptually adopted, that is, an abstract of a more complex, articulated, and elaborate document, designed specifically as a summary

for the purpose of informing legislators of the British parliament in regards to the essential elements needed to participate in twentieth-century parliamentary sessions (Kantor, 2009). The modern White Paper is therefore a positioning document and vehicle of concisely composed and easily accessible scientific information, or, as Michael Stelzner stated, *"a document that usually describes problems and how to solve them. [...] It introduces a challenge and makes a strong case why a particular approach to solving the problem is preferred."* (Stelzner, 2007). The purpose of this document is therefore to educate, inform, and raise awareness of the complex and multifaceted relations between Flow Wrap Packaging and Sustainability. In this case, however, the recipients are not only policy makers, but also the greater public, whose responsibility is no less onerous than that of politicians (we must not forget that the choice to purchase, made every day, can also represent a political choice). And to do so synthetically, to cater as much as possible to the need to combine the enormous quantity of information available to us insofar as twenty-first-century readers, with the little time we have to metabolise it. Last but not least, the decision to propose a White Paper as opposed to another form of publication, was driven by the free dissemination of information. In order that as many people as possible can be informed of the contents of this document, it was decided to make it freely usable in Open Access and shareable with everyone.

Its release, scheduled for 2022, is symbolically representative of a special year, the eighty-fourth anniversary of the worldwide filing of the GB495946A patent entitled *"Improvements in wrapping machines"* for a wrapping machine by Samuel John Campbell. And the setting chosen for its presentation is the 2022 edition of IPACK-IMA (scheduled from 3-6 May, 2022, in Milan, Italy): an internationally acclaimed event for industry professionals, as well as a privileged meeting place for food and non-food industry buyers, a not-to-be-missed occasion for more than 74,000 visitors, set to represent the genuine start of the post-pandemic recovery for all sectors present.

The target audience?

The cultural-technical-scientific analysis proposed here seeks to be an aid, in today's increasingly complex and multifaceted thematic landscape, for both experts, taking into close consideration the influences which can be stimulated even by the paradox of plastics and problems tied to the disposal of compostable materials, and also for the greater public who use flow wrapping, the end customers who choose the product, consume its contents and complete (one hopes) the life cycle of the packaging, disposing of it in the most appropriate way. For the latter, the aim is to stimulate curiosity and raise awareness: this light and flexible packaging in fact protects and guarantees the safety of its contents, from snacks, to medicines, to pharmaceuticals, to personal care products, to electronics, and even e-commerce, in our everyday life and in exceptional circumstances, and if disposed of correctly, transforms into a secondary raw material and is reborn into a new life.

The aim of this publication is to analyse flow wrap packaging as an industrial product, to open up to the greater public, to examine it with both a microscopic and telescopic lens, in order to understand the high-level complexity hidden in every stage of this "small" packaging's life, but also the large number of parties involved: from the producers of the semi-finished product, to the designers of the packaging itself, to the producers of packaging machinery, to distributors, to those who eventually consume the packaged product, and who make the recycling and recovery of materials possible.

From linear, to nonlinear, to circular: a multilevel reading

The contents of the following pages are divided into levels, and the structure of the publication itself, designed *ad hoc* to launch a message (or perhaps more than one), seeks to give the reader an overview in case of a linear reading, that is, from start to finish. In a logical path that weaves its way through the different sections, the reader is offered the perspective of those who have been, are, and will be the protagonists or witnesses of this journey.

Three short opening essays give voice to the most important associations of packaging machinery producers, representing both the international and national spheres respectively (through the words of Jim Pittas, President of PMMI – The Association for Packaging and Processing Technologies, and of Riccardo Cavanna, President of UCIMA – Unione Costruttori Italiani Macchine Automatiche per il Confezionamento e l'Imballaggio for the period 2022-2024, and Alberto Palaveri, President of the GIFLEX - National Association for Flexible Packaging - Assografici, the Italian Printing and Paper Converting Industries Association for the period 2021-2023). A foreword written by packaging journalist and expert, Luca Maria De Nardo, captures the reader's attention and transports them into the world of packaging, from its origins to the present day, from packaging designed by nature to flow wrap packaging, invented and perfected by humans. This introduction, compiled by the publication's editors, Beatrice Lerma and Doriana Dal Palù, both Assistant Professors in Design at the Politecnico di Torino, describes the genesis of the project, its research question, the main future challenges, and serves as a prelude to the main body of the White Paper.

The main body is an articulation of scientific and cultural insights, organised into different types of contributions. It is introduced by the section called "FlowSearch", a collection of time pills that trace the main milestones from the 19th century to the present day and beyond,

which allowed the birth, development, and diffusion of flow wrap packaging and the concept of sustainability in over two centuries of history, seeking to give the reader the necessary "time anchors" to continue reading. This is followed by an alternation of sections dedicated to: interesting facts about eco-packaging, a list of 5 valuable insights from the international flexible packaging scene, helpful in projecting towards possible future material scenarios for the flow wrapping sector; chapter topics, which are the scientific backbone of the publication, compiled by 8 researchers from 5 different Italian universities (Università Iuav di Venezia, Alma Master Studiorum – Università di Bologna, Politecnico di Torino, Università degli Studi di Milano Statale, and Università degli Studi di Salerno), which through essays respectively dedicated to packaging design, the contemporary role of flow wrap packaging, usability and interaction with flow wrap packaging, the technologies and materials used to make it, and finally the challenge of sustainability and the *plastic paradox*, frame the theme and transfer to the reader the cultural background needed to understand the complexity of this technology; company stories, the cradle-to-cradle journey of flow wrap packaging, which, through 8 Italian and international companies, covers the entire supply chain from the production of the film, to the production of packaging machines, to producers of food – where flow wrap packaging plays a key role – to large-scale distribution,

and finally to waste disposal and recycling centres, where the packaging material is revalued and prepared to re-enter a virtuous cycle, in a new life; people's voices, a selection of reflections extrapolated from the numerous interviews with those who are – or have been – protagonists or witnesses of the development of this technology from its beginnings to the present day.

The document concludes with a series of reflections by different voices, which envisage new scenarios and future challenges for flow wrap packaging, considering the medium, short, and long term, enlightened by cultural insights inspired by research (and the contributions you will shortly read), and which raise new questions and a handful of affirmations.

The multilevel structure of this document, in addition to the hypertextual elements, also lends itself to a nonlinear reading, affording the reader specific insights and considerations, each complete in their current, minimal set of information, but with the possibility for expansion.

Lastly, the entire publication lends itself to a circular reading, insofar as each section is not an end in itself, but rather reconnects to the other sections (for example, the story about the company dedicated to the recovery and recycling of plastics, and the story about the company that produces packaging film).

The different roles of Universities

The role of Universities, in this case the Politecnico di Torino, represented by the publication's editors, but also the authors of each chapter, researchers, and professors of the various Italian universities, is to act as a bridge between the different banks of knowledge, a guide informed by the scientific knowledge and research methods characterising the current debate, fulfilling all three academic *missions*: teaching (in this case understood as "education"), research, and the third mission, that is, the transmission of knowledge beyond the University boundaries, to the greater public. By identifying the most influential spokespeople for each section and guiding the reader (for example, through abstracts that introduce the various sections of the publication like a voiceover by the narrator), the University also becomes a source of information drawn from the sphere of national and international research on the main macro-themes of the publication (packaging design, the contemporary role of flow wrap packaging, the interaction and usability of flow wrap packaging, the materials and technologies used for flow wrap packaging, and new scenarios for the eco-sustainability and innovation of plastics), and also a translator of complex information into a form accessible to a more general public. The entire paper is characterised by a poly-technical approach, reconnecting the business world to research, interesting facts to thematic contributions, the past to the future. A chorus of voices, points of view, and factual stories, essential in addressing such a complex issue.

Lastly, another role that can be played by Universities, no less important than the previous ones and exemplified by this very publication, is to support a focus on the most pressing issues shared by the entire supply chain, serving not only to provide information, but also to inform the relative political and economic decisions.

What are the take-home messages?

In conclusion of this project, new horizons are envisaged for the sustainability of flow wrap packaging. A sustainability, which, in light of all the considerations shared in this paper and

the contributions collected from the world of research, from the flow wrap packaging supply chain, and from key institutions, is necessarily based on the idea of circularity. Innovative (but also traditional) materials play an important role and demonstrate that the future can be multifaceted and multidirectional, even if some materials – for various reasons – are not yet entirely ready to fully accept the technological challenge of flow wrap packaging. Reconnecting with the end users and consumers of today, but even more so of the following decades, will be essential in promoting circular processes designed to enhance the value of the materials currently in use, limiting any further exploitation of available resources, whether renewable or not. To achieve this objective, users should have already been educated and informed, or at the very least, must now be provided with clear and unambiguous information regarding what happens to the waste after it is sorted in the various recycling bins. We need to better inform society about the "magic" that takes place in waste centres thanks to mechanical and chemical recycling to ensure a more effective and productive effect on everyone's habits. The mechanical and chemical recycling of plastics will likely lead to tangible solutions contributing to the new life of polymers, but overcoming the challenge of sustainability will require significant action on the part of trade associations and manufacturing unions, responsible for translating the needs of the entire flow wrap packaging sector to the political world. Only then will flow wrap packaging be able to re-acquire its essence as an ethical packaging, reuniting its origins of democratic, light, high-tech, and safe packaging, using minimal materials of a sustainable nature, close to both people and the Planet.

Sources

Giedion, S. (1948). *Mechanization takes command. A contribution to anonymous history*, Scranton, Pennsylvania (USA), W. W. Norton & Company.

Bassi, A. (2015). *Food design in Italia. Progetto e comunicazione del prodotto alimentare*, Milano (Italia), Mondadori Electa.

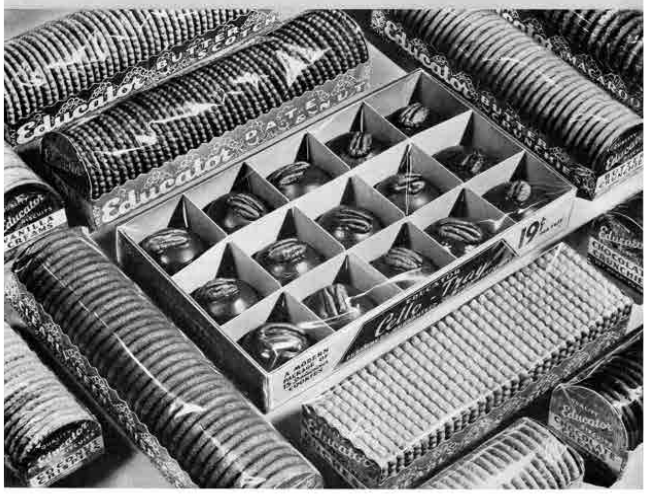
Kantor, J. (2009). *Crafting White Paper 2.0. Designing Information For Today's Time and Attention-Challenged Business Reader*. Raleigh, North Carolina (USA), LuLu Publishing.

Stelzner, M. (2007). *Writing White Papers: How to Capture Readers and Keep Them Engaged*. Poway, California (USA), WhitePaperSource Publishing.

"THEY LOOK BETTER...STAY FRESHER...SELL FASTER" IN 'Cellophane'

TRADE MARK

says Mr. R. L. Megowen



MEGOWEN-EDUCATOR'S President, Mr. R. L. Megowen, says:

"The success we have enjoyed with our own fully visible packaged line is ample proof that this modern packaging idea has made the old cracker barrel as extinct as the dodo.

"Packages of 'Cellophane' make it easy for retailers to set up attractive, colorful displays. But more than that, 'Cellophane' cellulose film gives sanitary protection from handling and protection against atmospheric conditions. And 'Cellophane' lets shoppers *see* color, quality, variety and texture . . . adds a look of prestige.

"Modern production methods in baking and packaging with 'Cellophane' make it possible to bring oven-fresh, crisp biscuits in convenient-size packages to the consumer's home in large volume at reasonable prices."

DO YOUR SALES SATISFY YOU?

● If they don't, a new package may be part of the answer you want. One of our Field Representatives will be glad to cooperate on packaging plans. No obligation. Just write: Du Pont, "Cellophane" Division, Wilmington, Del.

Cellophane

TRADE MARK

"Cellophane" is a trademark of E. I. du Pont de Nemours & Co., Inc.

DU PONT

THE SATURDAY EVENING POST

MRS. KAY TRIES SOMETHING DIFFERENT

Cellophane

DU PONT

BETTER THINGS FOR BETTER LIVING ...THROUGH CHEMISTRY

THE SATURDAY EVENING POST

HERE'S WHY CHIPS ARE EXTRA-WONDERFUL IN CELLOPHANE

You see what you buy in Cellophane. No scatimon! You're sure to get appetizing, crisp-crunch chips every time.

You're sure food is in Cellophane is clean —safe from dirt, flick or handling. That's a wise health safeguard.

Mmm. Fresh and delicious! Moisture-proof Cellophane seals in crispness, flavor... brings you chips at their tempting best.

DU PONT Cellophane

DU PONT

BETTER THINGS FOR BETTER LIVING ...THROUGH CHEMISTRY

Look at "Cavalcade of America" on Television

THE SATURDAY EVENING POST

CELLOPHANE PROTECTS U. S. ARMY EMERGENCY RATIONS

Packaging material used to protect your foods meets extreme conditions in field service

Uncle Sam's soldiers are fed better than any other army in the world. Even the soldier who digs in at an advanced outpost doesn't go hungry. The U. S. Army Quartermaster Corps equips him with compact emergency food rations scientifically selected and scientifically packaged to keep in perfect condition, winter or summer, rain or shine, jungle or desert.

Many of these energy-giving foods are wrapped in Cellophane by U. S. Army specifications to protect them against moisture, dirt and other harmful elements. Cellophane protects the freshness and nutrition of these special rations under the most severe field conditions.

This wartime use of Du Pont Cellophane serves to emphasize the degree of protection it gives the foods you buy in the stores — preserving flavor, minimizing waste.

WHAT IS AN ARMY EMERGENCY RATION?

IT IS A CONCISE ASSORTMENT OF VITAMIN-RICH AND ENERGY-GIVING FOODS [illegible] CONCENTRATED ENERGY-GIVING FOODS IN COMPACT FORM WITH MINIMUM WEIGHT. THERE ARE A NUMBER OF DIFFERENT ASSORTMENTS, EACH SUITED TO SOME PARTICULAR NEED OF AN ARMY IN THE FIELD.

FOR INSTANCE, FIELD RATION "K," WEIGHING ONLY SLIGHTLY OVER 3 POUNDS CONTAINS THREE DIFFERENT MEALS [illegible] FOODS ... BISCUITS, CHEESE AND SUGAR. IT IS PERFECTLY BALANCED FOR GREATEST ENERGY, AND CONTAINS BEEF, CHOCOLATE AND [illegible] CEREAL, ETC.

DU PONT Cellophane

DU PONT

This collection of "time pills" traces the main milestones from the 19th century to the present day and beyond, which allowed the birth, development, and diffusion of flow wrap packaging and the concept of sustainability in over two centuries of history, seeking to give the reader the necessary "time anchors" to continue reading.

FlowSearch

by **Ottavia Burello**, Short-Term Research Fellow, DAD – Department of Architecture and Design, Politecnico di Torino

From the 19th Century to the '20s

1817

The first **cylindrical machine for the production of paper** is installed by Thomas Gilpin in Delaware (USA), and used to develop cartons and others forms of paper packaging. This gives life to "**flexible packaging**"

1852

The invention, by Francis Wolle, of the **machine used to produce paper bags** offers an additional push towards the use of new types of **packaging**

Late 19th century

Cardboard, vacuum containers, collapsible tubes, corks are used, as well as automated machinery to produce bottles, four-colour lithographic printing. America launches the challenge: shipping, advertising, free samples. **Packaging is a carrier for sales**

1890

The **folding cartons** by Robert Gair are used by the company **Nabisco** to **package crackers.** This moment is credited as the **birth of the folding carton**

1896

Nabisco introduces the boy in the yellow raincoat in its advertisements and packaging to emphasise the **moisture barrier.** Uneeda biscuits are wrapped in a **wax-coated paper lining** and placed inside a tray-style **carton**

1911

Tobler Company uses **aluminium foil** to wrap the **Toblerone chocolate bar**. The following year, Maggi uses the same material to package soap bars and bouillon cubes. Today, both brands are part of the Mondelēz International Group

From the ‘30s to the ‘40s

1916

Clarence Saunders’s **Piggly Wiggly** stores are widely credited with introducing **self-service grocery shopping** to the US

1923

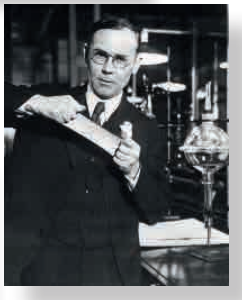
The Coesia Group (Italy) is formed around GD, a **producer of motorcycles**. Thanks to an acquisition policy, the **attention is shifted to packaging** in the confectionery and soap sector (and beyond). The **first wrapping machine** would later be launched, an innovation guaranteeing high performance for the era

1930

The **first King Kullen supermarket** opens: Michael Cullen rents a **garage** in New York (USA) that would soon be structured with employees, air conditioning, refrigeration cells and **ad hoc packaging**

1933

PMMI (Packaging Machinery Manufacturers Institute) is created in response to the National Industry Recovery Act, enacted **during the Great Depression**. Thirty-five businessmen in the **packaging machinery** sector meet in Buffalo, New York (USA) to form an association to protect the packaging machinery industry at the Department of Labour



1935

Wallace Carothers is the first to synthesise Nylon (polyamide), a material that would spread with **the Second World War to serve the American troops**, but also for other textile applications, such as **tights**

1937

The first **Nylon yarns** are introduced to the market

Imperial Chemical Industries (UK) obtains the first patent for the **ethylene polymerisation** process

1937

In Italy, **Mario Pavesi** starts producing the new "**Novara biscuits**" (which would give rise to the famous "Pavesini" in 1954, patent no. 107039), which, compared to traditional types, **are smaller with a lower moisture content** for easier **packaging and preservation**

1938

Glassine (or **pergamine**), **thin and transparent**, **wax-coated** paper is introduced: it provides **good protection against moisture**. However, it is not effective as a barrier to grease and odours

1938

Samuel John Campbell (USA) patents a **wrapping machine** consisting in tools that continuously move a strip of **wrapping material** on which **items are deposited one after the other,** and a **photoelectric device** to control the correct positioning of each item (GB495946A)

1939

DuPont produces a commercial video teaching **sales techniques** and **buying methods** for the domestic market, promoting the use of **Cellophane packaging**

1942

The **K-ration** is born **(in honour of husband and wife, Ancel and Margaret Keys, its "inventors")**, an emergency food (but also non-food) ration for US paratroopers in the Second World War. The ration needs to weigh very little and fit in a uniform pocket, or backpack. The (essential) external packaging is in **wax-coated and waterproofed cardboard** to protect against moisture, while the meals are packaged in **wax-coated paper or Cellophane**. The K-ration concept is still used to this day

From the post-war period until the early ‘60s

1945

The film “**Plastics**“ is released, distributed by **Young America Films**, presenting the growth of the **plastics industry** and **new materials** developed during the Second World War

Post-war onwards

Consumption picks up again and **existing packaging solutions are re-invented**: plastic and cans become even more widespread

1947

The **Alleanza Italiana Cooperative di Consumo (AICC**, Italian Alliance of Consumer Cooperatives) is officially founded, which would later become Coop Italia

The ‘50s

Pavesi Autogrills, designed by leading Italian architects, are increasingly constructed along the national motorway network. Commercial intuition then leads to the emergence of **Motta-grills** and **Alemagna Autobars** all throughout Italy

1952

Hänsel Processing (formerly Otto Hänsel), a pioneer German company in the packaging machinery sector, achieves a number of milestones in the **development of confectionery production**, for example the **double-twist candy wrapping machine**

1954

In Italy, Giulio Natta experiments with the **stereospecific polymerisation of propylene**, later industrially developed by **Montecatini** and marketed as **Moplen**

1954

Crackers arrive in Italy from the US. Another type of baked product sold in **single-serve** packaging is born. A decade later, advertisements propose the image of a large loaf of bread, the slices of which are transformed into **crackers**, seconding the **dietary concerns** of a society that equates **a light product with a slim body shape**

Motta too begins the production of **RITZ crackers** under the licence of the US **NATIONAL BISCUIT COMPANY** (Nabisco), which had been marketing them since 1934

1955

The founder of the **Omori Group**, Shozo Omori, joins the packaging machinery sector with a machine for the automated cutting and bagging of fish sausages (chub packs)

1957

"**Supermarkets Italiani Spa**" is created: the **first Esselunga supermarket** is opened in Viale Regina Giovanna in Milan (Italy). **Bernardo Caprotti and Nelson Rockefeller** are among the founders

1959

In the USA, **Fenton McHugh Productions**, on behalf of **Milprint Inc.** (producer of candy packaging), produces a **mini documentary on the importance of packaging**

1960

Alan Pendry's award-winning short film The Shape of Plastics captures the versatility of plastics in its numerous new possible uses

1960

Mario Cavanna perceives the possibility to improve the **packaging machinery system**, making it more automated and applicable to **confectionery and baked products**

From the ‘60s to the end of the ‘70s

1961

The mechanics hall is set up at the **Fiera di Milano** to host **the first Ipack-Ima** exhibition, one of the **world’s most important exhibitions** for the packaging sector

1964

The Long Range Patrol or “LRP ration” is created, a freeze-dried field ration for the American army, designed to be **nutritious, light, and easy to transport**, a descendant of the dehydrated rations used by **NASA astronauts**. Given its tendency to deteriorate in humid environments (such as Southeast Asia), the rations are packaged in **clear plastic bags with zip closure**

The ‘60s and ‘70s

The **Mars bar recipe** (created in 1932 in the UK) is perfected: this version is distributed throughout the world and packaged in a **black wrapper with red lettering and gold edging** (still used to this day). In 1982, three million Mars bars would accompany the British task force to the Falklands

1971

Gary Anderson invents the **recycling logo** as we know it today: **three bent arrows** facing clockwise, which form a **Möbius loop**

1972

Germano Dalla Vecchia, founder of the **Dizma Group**, takes part in the Milan trade fair where an entire hall is dedicated to packaging machinery. He would go on to patent the **continuous thermoplastic film packaging machine**

The concept of sustainability is born: the **"Limits of Growth" report published by the Club of Rome** introduces the **theme of the non-sustainability** of a **development model** in which the Planet is considered an inexhaustible pit of resources at our disposal

1973

The Ferrero ad for **Mon Chéri chocolates** connotes the precious gesture of gifting biscuits and chocolates. The product is packaged just as it is today, a **double wrapping conferring preciousness** (enhanced by the shimmer of the outer plastic film)

1975

The first **bag of Mulino Bianco biscuits** hits retail shelves. Consumers are very keen, and Mulino Bianco quickly becomes the **leader in the Italian market for baked products**

1976

"The pack with the snap that's the packet in the pocket". **Ritter** introduces the **Knick-Pack**, packaging with a snap-opening for chocolate bars that rapidly develops into a brand feature

From the ‘80s to the 2000s

1985

GIFLEX is founded, the **National Association** that brings together **producers of flexible packaging** designed for food products, pharmaceuticals, chemicals, and other industrial applications. GIFLEX, with its 40 member companies, represents roughly 80% of the Italian market in terms of both volume and turnover.

This is also the year during which the first **tamper-evident** applications designed to guarantee integrity in the food sector are introduced. This element is an **absolute priority** in the packaging sector to **guarantee the safety** of the packaged product, protecting against all types of **tampering**. If opening is attempted, the label breaks and ruins the packaging, leaving an **evident sign**. Use of a Tamper-Evident system allows compliance with Resolution **2001/62/EU** for the **pharmaceutical sector**.

Also in the same year, **Reymond Clavel** of the Polytechnic of Lausanne deposits the patent for the **Delta robot**, receiving the **Golden Robot Award** in 1999. This new type of robot was designed to **handle** small and light objects at **very high speeds**, a very important **industrial requirement** at that time. Today, similar robots are used in picking and in the packaging industry, making more than **300 picks per minute**

1987

The World Commission on Environment and Development, **WCED**, established in 1983, presents the **“Our common future”** report (later known as the Brundtland Report), formulating a guideline for sustainable development, still valid to this day

1989

The Magnum ice cream (Algida, Unilever), transforms an ice cream bar f**rom a simple street food to a fashionable and glamorous product**, whereby its visual identity – through the wrapping – becomes of fundamental importance

1990

Novamont begins to market **MaterBi**, the first and best known of the polymeric materials obtained from renewable (corn starch) and **compostable** sources

1991

The first **tags** containing **micro printed circuits** are introduced to the American distribution process: **RFID technology**, a radio frequency identification system, takes its first steps

1992

At the Rio de Janeiro conference on the environment and development, the **Earth Summit**, the world heads of state come together and address emerging **environmental problems** on a global scale for the first time. The definition of **sustainable development** is consolidated

1994

Europe adopts the first **EU law on packaging recovery and recycling**, seeking to streamline the objectives, priorities, and criteria for its **prevention, recycling, and recovery**

From 2000 until today

2002

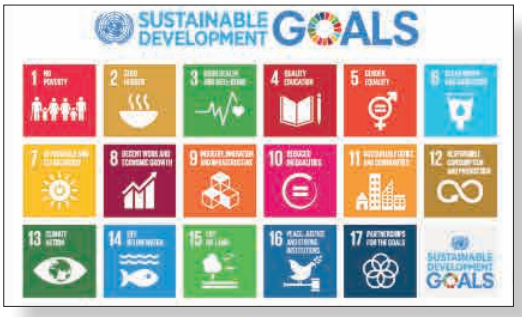
Following the World Summit on Sustainable Development in Johannesburg (South Africa), the term **sustainability** is incorporated and used by **politics**, **finance**, **mass media** and civil society **organisations**

2008

In accordance with the Government's Waste Strategy for England and Wales, Tesco proposes the **Sustainability Statement**, a document formulated to **reorient its use of packaging towards coordinated management with waste centres**. Other large-scale distribution companies would follow this example

2010

Taghleef Industry presents NATIVIATM film, a **new bioplastic packaging material made from BoPLA**, a renewable raw material



2015

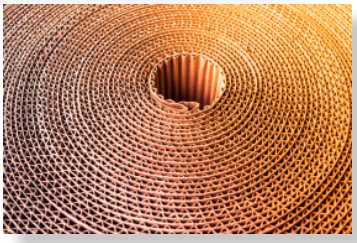
The **2030 Agenda for Sustainable Development**, a plan of action for people, the planet, and prosperity, subscribed to by the governments of 193 member states of the United Nations, and approved by the UN General Assembly, defines the **17 Sustainable Development Goals, SDGs** to be achieved in the environmental, economic, social, and institutional spheres by 2030

2015

The **Ethical Packaging Charter** is introduced, a document listing 10 values to help guide packaging towards a more conscious and sustainable future

2018

Extended Producer Responsibility (EPR) is an environmental policy, making **producers responsible for the entire life cycle of products** placed on the market, from their design to end-of-life (including waste **collection** and **recycling**). In **compliance with the minimum requirements set out by Directive 851/2018, the EPR must be effectively applied in the packaging sector by the end of 2024**



2019

France and the Netherlands launch the **European Plastic Pact,** a pact to unite governments, companies, NGOs, organisations, and leaders of European nations to **promote the transition towards a circular plastic economy**

2019

The **Aticelca 501/19** system is introduced, an assessment method able to determine the level of recyclability of materials and products made from paper or cardboard

2021

The first **PET plastic bottles produced entirely from enzymatic plastic recycling** make their début, thanks to the experimentation of a network of companies including Carbios, L'Oréal, Nestlé Waters, PepsiCo, and Suntory Beverage & Food Europe

2025

Circular Economy for Flexible Packaging (CEFLEX) is a collaboration between more than 160 European companies, associations, and organisations representing the entire **flexible packaging value chain**. The aim: to make flexible packaging circular in Europe by 2025

Did you know that this flow wrap packaging uses 70% less plastic?

MonoFlow re PXC

by **Ottavia Burello**, Short-Term Research Fellow, DAD – Department of Architecture and Design, Politecnico di Torino




MonoFlow re PXC is a highly transparent and completely recyclable polypropylene (PP) flexible film designed by the company Shur Flexible. It is ideal for delicate products such as fresh meat, but also cheeses or fresh pasta. The solution is proposed as an alternative to thermoformed trays or containers, allowing a saving of up to 70% on virgin plastics. The final packaging therefore weighs less and uses less plastic. This optimises energy consumption and space requirements during production, storage, and transport. It also offers high performance in terms of oxygen and aqueous vapour barriers, and can therefore be efficiently processed on existing flow wrap packaging lines. It is compatible with flexo, gravure, or digital printing. It also won the coveted Germany Packaging Award 2020 in the sustainability category, allowing Feneberg to save more than 36 tons of plastic per year for the packaging of its products, such as fresh minced meat, also thanks to Ulma Packaging, a manufacturer of packaging machines for the new packaging.

You cannot talk about flow wrapping without reference to the category of flexible packaging; you cannot talk about flexible packaging without talking about packaging; and you cannot talk about packaging without talking about packaging design. Flow wrapping and packaging design are intimately connected: find out more through the words and experience of Laura Badalucco, who describes the main functions and various types of packaging and illustrates the biggest issues faced by packaging design today, from which flow wrapping cannot escape.

Contain, protect, communicate. Packaging and design

by **Laura Badalucco**, Full Professor of Design, Department of Architecture and Arts, Università Iuav di Venezia

In the course of its long history, packaging has significantly broadened its role and, as a result, its pervasiveness and presence have increased in our systems of production, distribution, and consumption, becoming a constant in our daily lives and in the sustainability (environmental, economic, social, and cultural) of our usage and consumption.

It has been a long process in which the meanings, functions and system of packaging have changed in direct response to social, cultural, technical, economical and environmental transformations, calling for an increasingly more attentive and far-reaching design. We could speak of packaging as an artefact, which in spite of its short – and often disposable – life, is characterised by remarkable structural, technical, semantic, communicative and systemic complexity.

Designing packaging therefore means considering a range of different aspects, different functions, different interactions (with the packaged product, with the different parties involved in the production chain, with the different means of transport). This complexity is highlighted precisely in the definition provided by the regulation, wherein packaging is understood to be "the product, composed of materials of any nature, used to contain certain goods, from raw materials to finished products, to protect them, to allow their handling and delivery from the producer to the consumer or user, to ensure their presentation, as well as disposable items used for the same scope".[1]

Functional vs commercial packaging

When we talk about packaging[2], we normally mean the commercial type as opposed to the functional type, insofar as a product that constantly evolves to satisfy an increasingly wider range of needs. In summary – and following the key milestones in the history of packaging innovations[3] – we could say that it needs to be:

1 Law Decree 152/2006, art. 218.
2 The difference between commercial and functional packaging is subtle but important, insofar as the former mainly refers to the functions of protection and preservation, as well as structural, textural, and logistical aspects, while the latter also covers all the material and immaterial values, informative, communicative and service elements. See Anceschi (1992), p. 125.
3 See, for example, AA.VV (1994), Ambrose (2012); Badalucco (2011), Bucchetti (2005), Opie (1989).

- protective;
- communicative;
- informative-educational (in particular for food or household products for example, which require knowledge not only of the product's characteristics, but also how it can be used);
- service (for example to provide handles, dispensers, and easy-opening systems, but also childproof systems or snap-packs and cheerpacks for consumption on the go);
- functional (this term implies both so-called active packaging and smart packaging, which are often aimed at increasing the product's shelf life, that is, the length of time for which a product remains usable, fit for consumption or saleable, particularly foodstuffs);
- augmented (increasing the possibilities for user interaction through the application of static digital or moving images with augmented reality solutions).

Moreover, when we speak of packaging, we are not referring to a single artefact but rather several elements forming an integral part of a system with distinct, but nonetheless integrated functions. According to the regulation in fact, packaging is divided into:

- sales or primary packaging: this is packaging that packages the single product ready for consumption, is in direct contact with the contents and constitutes a unit of sale. Examples include a bottle of wine, a can of peeled tomatoes or a bottle of detergent;
- multiple or secondary packaging: in this case, the container collects a certain number of individual products of the same type, each in their primary packaging. It can be removed without altering the characteristics of the product;
- transport or tertiary packaging: designed to facilitate the handling and transport of goods, of a certain number of units of sale or multiple packaging. Examples of this type of packaging include pallets or crates used to protect and facilitate goods handling during transport, however road, rail, sea and air freight containers do not belong to this category.

This distinction, however, is not always clear-cut, and in some cases the different types might have blurred boundaries, or else the packaging might have functions that fall under more than one type, or even acquire additional functions once it gets to the point of sale.

Packaging for e-commerce, for example, unlike traditional commerce, might contain only one product unit or very different product units, despite being de-

signed to protect this product unit during the many trips it will have to make before reaching the buyer. Other special situations include those for feature displays typical of large-scale retail: from pallet boxes to floor displays and Shelf Ready Packaging (SRP), where the boundaries between secondary and tertiary packaging are somewhat blurred. Given its wide range of applications and the requirements it needs to satisfy, packaging can assume many different forms in very different materials: from cardboard boxes and cartons to polymeric bottles, trays and bags, from aluminium cans to glass bottles and jars, from wooden crates to pallets, and even strapping and shrink film needed for transport.

We can therefore design rigid or flexible packaging, adopting a variety of measures that need to consider first and foremost the relationship between the content and container, but also the specific aspects of the production process, distribution method, key players within the system and actions performed throughout its life cycle.

Flow wrapping

Among the different types of packaging, when we talk about flow wrapping we mean the type consisting in a "pillow-shaped pouch made from flexible film sealed in such a way as to obtain a tube, which is then closed on both ends, again by sealing, and then cut."[4]

Flow wrap packaging is mainly used in the food sector (but not exclusively) and aims to avoid alterations to the product (chemical, sensory, etc.), by protecting it with special techniques in terms of the machines and materials used to make the packaging, so as to increase the shelf life of the products contained therein.

This type of packaging can essentially be designed to contain solid products (baked goods, confectionery, fruits and vegetables and even certain medicines), but also granular products (such as rice, pasta or frozen foods), powders and liquids. Depending on the contents, the packaging machine can be either horizontal (for "sorted" products such as melba toast, bars), or vertical (for "unsorted" products such as powders, liquids and granulates).

The material used to produce this wrapping can be a polymeric film derived from a fossil or alternatively

4 Bucchetti, Ciravegna (2009), p. 56.

renewable source, of organic origin, and where possible, biodegradable or compostable.

The advantages of this type of solution are mainly the speed of packaging, quality of sealing, lightness, use of a limited quantity of packaging material per unit of contained product, and the simplicity of the production process which facilitates customisation and the use of flow wrapped products even in scarcely industrialised contexts.

Challenges and frontiers of packaging today

The lightness of packaging with respect to the product it contains, and the materials used to develop the packaging, are themes which direct our attention to yet another critical aspect when designing a packaging system: that of the associated environmental issues, with a particular focus on waste management, but even more so, prevention.[5]

Being so central to our reflections on packaging, and especially food packaging, environmental preferability has been and continues to be the focus of continuous studies and innovations. Italy is at the forefront in this respect, in terms of both recyclability and methodology, thanks to the diligent work carried out by the consortia of companies that both produce and use packaging, created in response to the so-called Ronchi Decree (Law Decree 22/97).[6]

It should be noted that there are also other strategies in place specifically regarding packaging design, with a view to preventing problems rather than managing them. According to the Italian Institute of Packaging, it is in fact estimated that the design process is responsible for about 80% of the environmental impacts associated with packaging, meaning it is precisely during this stage that we need to effectively intervene. It is important to clarify, however, that the reduction or elimination of packaging is not an absolute waste prevention strategy, quite the contrary. The design necessarily needs to find a balance between an increasing quantity of packaging and the associated environmental impacts, because although overpackaging is fraught with problems, underpackaging is even more problematic insofar as it can potentially cause the packaged product to be lost before it even reaches its destination, with subsequent environmental (as well as economic) damage, which can be ten times greater than that caused by packaging waste.

In addition to recycling, packaging design is also working in other directions of particular interest. These include the study and application of innovative materials, the lengthening of the life cycle of the product-packaging duo, and the efficient reuse of packaging (an increasingly important issue in need of further research). There are already a number of very interesting experiences in this regard, even in the large-scale distribution sector, as well as several revealing experiments in the e-commerce sector.[7]

Packaging design

As we have seen, all these aspects are intricately connected to packaging design insofar as an upstream approach is needed with a view to prevention, as required by European and national regulations, before problems arise which then need to be dealt with.

In the field of packaging design, we can seek to innovate either a single type of packaging, a combination of two types (especially in relation to cost, material or waste reduction strategies), or the entire system. This last road may lead to more radical innovations, but is no doubt the most complex situation to manage.

This is also because the packaging design and production process involves numerous players, each with very different and sometimes even conflicting needs.

In fact, given the complexity of the specific skill set and knowledge required, the design process cannot be managed by a single party of the entire system, even in the presence of well-defined roles and responsibilities for the project's development.

---

5 See, for example, Badalucco (2011), Biondi (2003), Boylston (2009), ECR Europe (2009), Jedickta (2009).
6 CONAI and other industry consortia constitute the "measure by which packaging producers and users ensure that they achieve the recycling and recovery target of packaging waste provided for by law" (www.conai.org).
7 In this regard, see the publications available on the Ellen MacArthur Foundation website (www.ellenmacarthurfoundation.org).

Packaging design must pay attention to the signals arriving from society, understand any changes, identify new consumer habits and categories, and likewise be able to experiment with the results of innovative technologies and materials, in particular with a view to sustainability and regeneration.

A packaging design is thus configured as a rich and articulated process, which can be adapted with incremental (most of the time) or disruptive (in rarer cases) innovations concerning:

- form and structure (understood as a set of structural and textural elements);
- communicative aspects (understood as a set of graphic, persuasive, identifying and informative elements);
- service (understood as a set of elements determining functionality, in-use performance and any active, smart or augmented functions).

It should be remembered that a new packaging design must nonetheless begin with an assessment of the characteristics and type of product that will be packaged, before going on to define the type of packaging and material most suited to protecting the contents. Only afterwards can we go on to design the form of the packaging, its wearability, methods of use, aspects related to logistics, its display in the point of sale and the management of strategies for its recycling or re-insertion in the production cycle.

All this can lead to the review of existing packaging or design of new packaging, considering the priorities of the key parties on the receiving end of the innovation.

In a nutshell, the challenge of packaging design is precisely that of being able to identify the connecting elements between the various objectives, and combine them in an efficient, convincing and sustainable way.

Sources

Ambrose G., Harris P., *Il manuale del packaging*, Zanichelli, Bologna 2012.

Anceschi G., "L'involucro transitorio", *Imballaggio*, n. 439 – September 1992.

Badalucco L., *Il buon packaging*, Edizioni Dativo, Milan 2011.

Bernardis M. (et al.), *Emballage, Emballages, Cité des Sciences et de l'Industrie*, Paris 1994.

Biondi V. (edited by), *Eco-design e prevenzione per l'imballaggio cellulosico*, IPA-Comieco, Ipaservizi Editore, Milan 2003.

Boylston S., *Designing Sustainable Packaging*, Laurence King Publishing, London 2009.

Bucchetti V., *Packaging design*, Franco Angeli, Milan 2005.

Bucchetti V., E. Ciravegna, *Le parole del packaging*, Edizioni Dativo, Milan 2009.

ECR Europe-Europen, *Packaging in the Sustainability Agenda*, ECR Europe-Europen, Brussels 2009.

Ellen MacArthur Foundation, *Reuse. Rethinking Packaging 2019*, 5th February 2022, www.ellenmacarthurfoundation.org

Ellen MacArthur Foundation, *Upstream Innovation 2020*, 5th February 2022, www.ellenmacarthurfoundation.org

Ellen MacArthur Foundation, *Extended Producer Responsibility 2021*, 5th February 2022, www.ellenmacarthurfoundation.org

Jedlicka W. (edited by), *Packaging sustainability*, John Wiley & Sons, Hoboken 2009.

Opie R., *Packaging Source Boo*k, Quarto Publishing, London 1989.

Before the '50s, everything was packaged at the time of distribution, and packaging had the sole task of containing, not presenting and preserving.

"Between the '50s and '60s of the last century, flow wrapping played a key role in the packaging of Alemagna Motta street ice creams. The products were inserted in preformed bags, which were then individually sealed. These were the first steps of a new culture developed through the evolution of mechanisation, whereby the packaging was prepared at the same time as it was filled. The new machines, starting from a roll of flexible film, produced the packaging directly around the product, an extraordinary turning point in the history of modern packaging."

Franco Goglio

Chairman and CEO, Goglio S.p.A.

The core business and distinguishing feature of Goglio S.p.A. is its system: founded in 1850, it offers turnkey packaging solutions through the combination of high barrier flexible laminates, degassing valves, packaging machines, technical assistance and service.

Today, converters are a bridge between the production of the film to be personalised and its machinability. Successful packaging is the product of close cooperation between the converter, machine manufacturer, and brand owner.

"The role of converters [1] *is to transform the client's* [2] *idea into something tangible: we help bring the client's idea to life by personalising the film, which is then printed, coupled, and finally cut. It is a question of providing a product characterised by high quality standards in terms of its graphic, chemical-physical, and dimensional features. Developing an innovation is just as important as the aspect of communication."*

1. Term used in Europe, the term "printer" is used in the USA.

2. Normally the producer of the consumer good in the packaging.

Fabrizio Gerosa

Sales Manager, Cellografica Gerosa S.p.A.

Founded in 1935 in Inverigo (CO, Italy), the company is today an international leader in the flexible packaging and labelling sector. For more than 85 years, it has heavily invested in the most cutting-edge technology, designing and developing sustainable and innovative solutions for a broad range of applications.

From granule to film for the packaging sector

Taghleef Industries

www.ti-films.com

Taghleef Industries, with headquarters in Dubai (United Arab Emirates), is a world leader in the production of flexible film packaging, labels, and technical applications characterised by high-level sustainability and innovation. It is one of the major producers of standard and special films in bioaxially oriented polypropylene (BoPP), cast polypropylene (CPP), and biodegradable films through industrial composting (PLA). The group has steadily grown, opening new production centres in key locations for the international market, supported by targeted investments for strategic organic growth.

The increasing emphasis on the issue of sustainability and consumer requests have been translated by Taghleef Industries into the Dynamic Cycle™ initiative, the aim of which is to help improve the quality of life of future generations. The company is aware of how important it is to offer clients and partners not only access to excellent solutions and services, but also a holistic approach.

This is the same context in which we find reDESIGN™, a service with the aim of facilitating Taghleef Industries clients in making the transition from traditional packaging to more innovative and sustainable solutions. Successful examples of this include the replacement of the PVDC lacquered film with EXTENDO® XFWM, a high barrier film that combines recyclability with maximum content protection.

In collaborating and working closely with partners, packaging industry experts and the entire associated value chain, the company has gained full awareness of the fact

that packaging must satisfy multiple needs, and at the same time, respond to the indispensable need to protect the product inside. New packaging materials cannot be developed without experimentation and testing on packaging lines, the last step of industrialisation. In this race towards sustainability, packaging materials and machinery evolve in parallel, striving to guarantee utmost performance and results.

Recyclability has therefore become an essential requirement, making it possible to keep the value of the raw material circulating. It is, however, equally important to acknowledge the environmental impact of packaging, and measuring its *carbon footprint* is a crucial aspect. The use of alternative raw materials, whether biobased from renewable sources, or granules from a recycling process, is set to become increasingly important moving forward. Also paramount will be the use of compostable solutions able to offer a different end-of-life scenario. This aspect may prove to be particularly important in cases where there is a limited availability of suitable infrastructures or systems for the collection, sorting, and activation of waste recycling, or in other cases still, where the packaging has been excessively contaminated by its contents, such as to exclude an efficient recycling process able to guarantee the high quality of the secondary raw material.

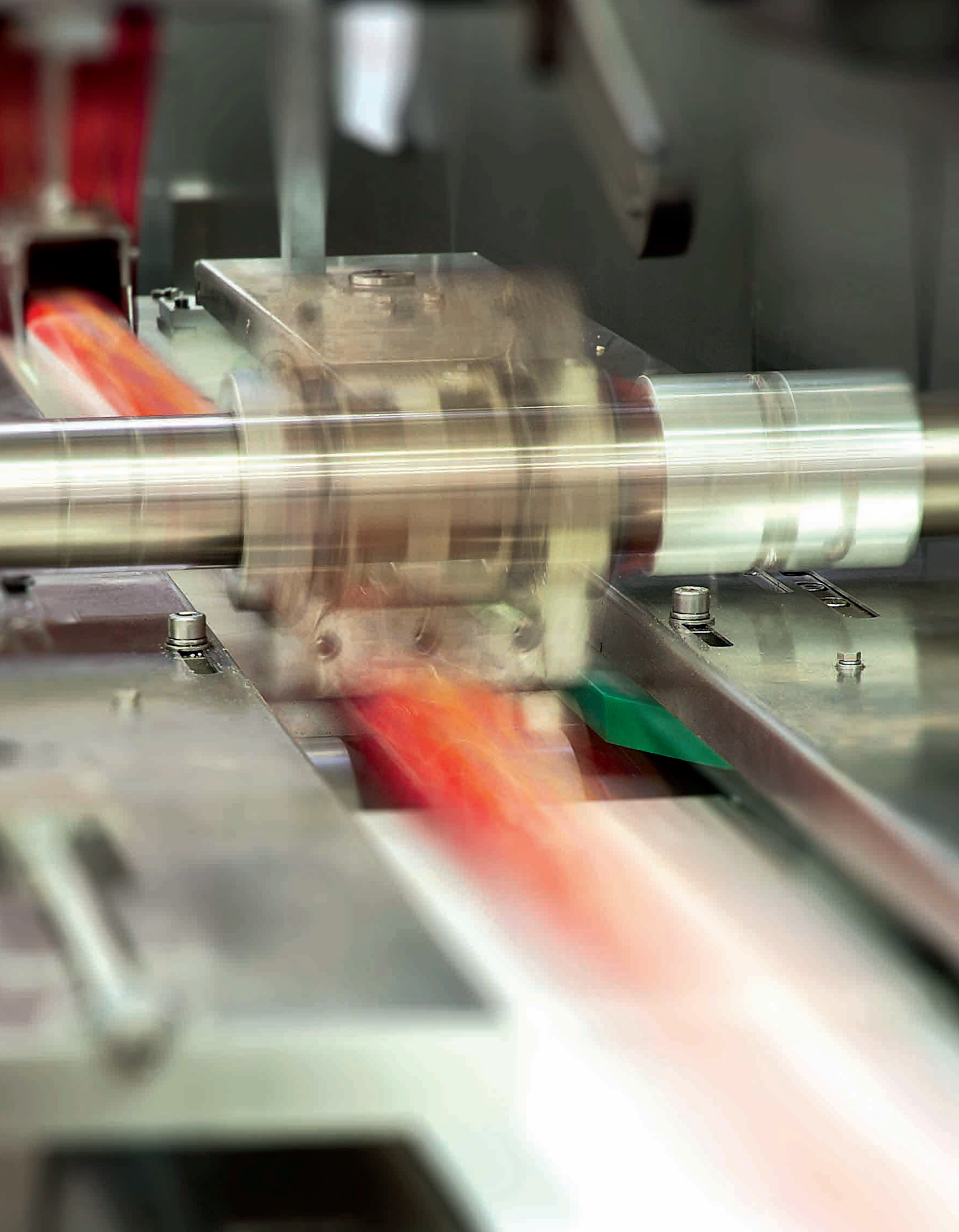
Our thanks go to Mario Molinaro and Monica Battistella, who in drafting this paper gave a voice to Taghleef Industries.

Did you know that it is an industrialised bioplastic derived from milk?

Lactips

by **Ottavia Burello**, Short-Term Research Fellow, DAD – Department of Architecture and Design, Politecnico di Torino

Lactips was developed in the Ingénierie des Matériaux Polymères (IMP) laboratory of the University of Saint Étienne (France), and is the result of 10 years of research by Fréderic Prochazka, professor, researcher, co-founder, and scientific director of Lactips. Lactips bioplastic uses the main protein of declassified milk, casein, which is renewable, biodegradable, edible, and compostable, allowing the development of a bioplastic without any significant toxicity after its dissolution in water. The material can be converted using traditional plastic processing techniques, and is compatible with vertical and horizontal packaging systems. Lactips has high oxygen, grease, and oil barrier properties, guaranteeing good printability and sealability. It is suitable for contact with food and has TÜV Austria, Ecocert, Ecolabel, and Nordic Ecolabel certification. It is most commonly used for single-serve packaging (solids/powder/tablets/liquids) and for hospital laundry bags.



The biggest issues faced by flexible packaging today have led flow wrapping, a democratic packaging characterised by a high value matrix, to be a guarantee of hygiene, quality and safety of the packaged product in various conditions of space and time, sometimes even "extreme": Clara Giardina and Flaviano Celaschi present a social, cultural and design-based interpretation of this apparently simple, but in actual fact complex industrial product.

The contemporary role of flow wrap packaging

by **Clara Giardina**, PhD Student of Architecture and Design Cultures, Alma Mater Studiorum – Università di Bologna
Flaviano Celaschi, Full Professor of Design, Department of Architecture, Alma Mater Studiorum – Università di Bologna

Technological culture and impact on society

The shapes of the artificial objects that surround us are largely the result of technological production needs linked to industrial processes. For roughly a century, they have been developed by machines designed to quantitatively (and therefore economically) scale the economic investment needed to make them. They are called industrial products and the parameters guiding the main production choices are time, space, and cost.

This has always been the case: mankind has gone through all the cycles of adapting to the Planet starting from "organic technology", if there was a problem, his first attempt was always to solve it by purposefully modifying his own body, and alternatively resorting to the use of organic materials: vegetation and shrubs, and other living organisms. This was also because organic raw materials had a naturally cyclical availability.

When it came to containing liquids and powders or substances made up of small fragments (like seeds) during the journey from the source or origin, or in the case of pre-agricultural nomadism, the most ancient solution adopted to our knowledge (for which very ancient remains have been found, and which is still used in many parts of the world today) is that of using animal skins, treated and sealed to create flexible vessels called wineskins. Goat stomach skins or those obtained by tanning animal skins are still used today, and were the solution adopted until the arrival of industrial technology. Curzio Malaparte, in the novel *Kaputt*, refers to the soldiers' amazement at finding "wine in sacks" during their invasion of Campania in the Second World War.

Hence the need to collect powders, grains, and liquids in containers able to retain their sensory and functional characteristics for a suitable period of time, is an age-old problem that has always been technologically resolved, in the vast majority of cases, by two practices:

the creation of terracotta vessels (normally a more rigid and heavy solution, more suited to large quantities for long trips or long-term preservation);

the creation of sacks in organic or artificial tissue (normally a lightweight and flexible solution, also in terms of shape, particularly suited to personal quantities or as a short-term solution to the problem).

The process for the second type is recurring and follows two alternative paths:

- we start from an organic or plant tissue already shaped like a tube: the issue is therefore how to seal one edge of the tube permanently, and the other in an openable way;
- we start from a flat organic or plant tissue: the issue is therefore how to bend and sew it in order to make a tube and then do the above.

To reach the present-day status, we skip two steps which are in actual fact quite difficult to summarise in a few words:

- how do we obtain an impermeable substance that can be produced in essentially infinite strips (rolls) with constant performance along its entire length, and which is therefore suitable for feeding in a process that uses rotary motion alternated with linear motion (industrial machines)?
- how do we seal these strips to obtain a tube shape and then seal the two ends of the tube to obtain a hermetic container?

This was the recurring industrial theme for decades, and the performance characteristics that revolutionised the solutions were influenced by polymeric materials. Right up until the second industrial revolution, during which, notwithstanding morphological, geometric, time, cost, and performance constraints, it became critical to find a solution to problems linked to the long-term sustainability of the process, and therefore to the rhythms of production circularity or management of system outputs.

Towards an industrial product

This historical transition therefore helps us to understand how flow wrapping – a "pillow-shaped pouch made from flexible film sealed in such a way as to obtain a tube, which is then closed on both ends, again by sealing, and then cut" – does not invent but rather translates an ancient need into modern technological terms, passing from organic to synthetic materials.

Flow wrapping belongs to that category of packaging which is "historically created and affirmed not only as a result of formal actions, but also by way of functional needs tied to specific packaging processes" (Ciravegna, 2017).

It is worth examining the morphological sphere of flow wrapping not only in terms of its historical evolution, but also in order to understand what it means to industrially and rapidly treat a substance, guaranteeing high standards of quality and safety: only then can one truly understand the typological inventiveness of the sealed tube.

Starting from the second industrial revolution, when we switched from hand-made to serialised objects, the number of objects grew dramatically and a new type of object was introduced, which was a direct result of the changed production methods. We therefore stepped into a new material culture which Maldonado defines as the "culture of physical objects created or manufactured by man, in their productive (and/or) symbolic practice". We entered an "industrial culture, where the ratios of production and consumption prevail, and the protagonist is the capitalist" who produces goods and services "materialising that which, little by little, becomes the portion of reality we can choose to change through a market exchange."

The wineskin and all its associated needs and peculiarities, thus becomes flow wrapping.

This typical re-invention of packaging fits into the English meaning of Design, in a design culture that thinks "the world of things, materials and forms within a social, political and economic framework" (Fiorani 2001, p. 59). What also emerges is the "nomadism of objects", which, in crossing over into other worlds and cultures, are able "to metamorphose" through adaptation and suggestion, but also re-invention (Fiorani 2001, p. 161). In this industrial period with soaring numbers, customisation did not yet exist and "the link between objects and their singularity was broken. Objects all became "copies" of a series and were no longer original" (Fiorani, 2001, p. 56). The consumer was still a long way from giving this unique and globalised product an ecological value, nor had they acquired today's widespread awareness of the importance of the content, hygiene, and safety of the container, for example.

The value matrix of flow wrapping is today easier to understand for general citizen-consumers, provided they are able to perceive the extent to which this type of packaging is in fact a "concert" by an orchestra of instrumental-

ists who need to agree upon and integrate, as best as possible, a symphony that is both harmonious and accessible.

Branzi speaks of the ear as a symbol representing today's "sensory revolution, where it is no longer necessary to 'understand' the internal mechanisms of phenomena, but to 'perceive' their effects, select the sounds and information, transform the grey mass of noises in space into culture."

The Designer-director, "a designer with an aesthetic sense that works for the community", "seeks to produce even the most common consumer products in the best way possible." (Munari, 1971, in Sacchetti 2010) Alongside, we find the tool of Technique. According to Dorfles, the key factor are technologies which in themselves identify the materials, transforming and combining them.

And next to Technique, we have the sound of the Material. "The materials tells us what the world is made of", and furthermore, "the adherence of the form to the nature of the material [is the] first basis of every constructive functionality.

Flow wrapping, boasting a technology that has been successfully adapted to a great variety of materials, has found its unique expression in polymericity. It has made plastics a "material of civilisation", exploiting their intrinsic complexity and high performance, beyond being a simple structure and integrating different functions. "Materials are becoming less "something with which to do something else" [...] and are becoming themselves "something that does" (Manzini,1986, p. 40 in Fiorani, 2001).

The social responsibility of flow wrapping

Having outlined the historical, morphological and technological framework, it is easier to understand which social

responsibilities and essential functions this type of packaging has managed to uphold, especially with respect to the variable of space.

Flow wrapping:

- guarantees accessibility to essential goods in extreme places and situations (e.g. wars, pandemics, climate disasters) while preserving their long-term quality, hygiene and safety;
- is extremely flexible in terms of distribution and logistics: it allows the optimisation of space during transport, and has an adaptive morphology with respect to new forms of distribution, from e-commerce to automatic last mile solutions.

Long-term impacts

Faced with the pressing need to consider the limitedness of resources, it is important to understand the advantages of flow wrapping in terms of sustainability, and its compatibility with an ecological conscience mindful of the future (Jonas, 2001 in Celaschi, 2016) and which reasons in a logic of circular health. If it is true that we need a people-planet-based design hinged on the variable of time, no longer "anthropocentric" but rather "anthropocenic" – which reflects on how the design itself "shapes reality beyond the morphology and functionality of the artificial things it designs" – then why promote single-serve (mainly polymeric) packaging today?

The aspects of the systemic environmental responsibility of flow wrapping can be summarised as follows:

- portionability (single-serve) ensures less substance waste (for example food and medicines), and significantly extends the safe shelf life of the product with respect to other types of multi-serve packaging;
- a much smaller amount of packaging material is used compared to other solutions with similar benefits;
- this type is often used to package products designed for people who live in "temporary living" or transitory situations in general: travellers, sports figures, business people, but also those just passing through. In these cases flow wrap packaging allows movement in hygienic conditions and reduces waste. One could speak of Time-based Packaged goods, in which the functional dimension is intertwined with the temporal and spatial one;

- this type allows innovative solutions with a lower environmental impact, such as concentrated/dehydrated solutions for home or personal care products.

Systemic effects

In observing all the evolutionary, relational, morphological, technological and responsible aspects, we can therefore try to understand the systemic-level effects of this typological category of packaging.

Some food for thought:

- it can be considered a democratic packaging by way of its accessibility, convenience, assurance, simplicity of production and environmental responsibility in overall terms;
- it has proven to be adaptive with respect to other system-product innovations in the same sector:
  - it enables the use of concentrated/dehydrated solutions for circular processes with a reduced environmental impact;
  - it adapts to material innovations;
  - it allows the implementation of innovations for logistics efficiency (e.g. automated transport, robotic movement, optimisation between primary/secondary/tertiary packaging);
  - it allows extreme customisation in new product categories (e.g. personalised and pre-dosed pharmaceutical therapies or supplements).

The social, cultural and design-based interpretation of flow wrapping explored herein, outlines a complex and high-value profile, in spite of its typological simplicity and the historical "humble origins" of its positioning in the space-time continuum.

In a logic of evolution in which we try to imagine any unexpressed possibilities, we could hypothesise an improved manifestation of the communicative potential of this type of packaging.

For example: more emphasis on customisation, the communication of brand value messages (potentially unique to each package), or the integration of technological and digital opportunities, may open up to new scenarios and new functions in terms of reliability, transparency or interactive consumer engagement.

Sources

Branzi A., *Modernità debole e diffusa*, Skira, Milan 2006.
Bucchetti V., *La messa in scena del prodotto*, Franco Angeli, Milan 1999.
Bucchetti V., E. Ciravegna, *Le parole del packaging*, Edizioni Dativo, Milan 2009.
Capua I., *Salute circolare*, Egea, Milan 2019.
Casoni G., F. Celaschi, *Human Body Design*, Franco Angeli, Milan 2020.
Celaschi F., *Non industrial design*, Luca Sossella Editore, Rome 2016.
Ciravegna E., "Diseño de packaging. Una aproximación sistémica a un artefacto complejo", *RChD: creación y pensamiento*, 2, 3, November 2017.
Dorfles G., *Introduzione al disegno industriale*, Einaudi, Turin 1972.
Fiorani E., I*l mondo degli oggetti*, Lupetti, Milan 2001.
Jonas H., *The phenomenon of life*, Northwestern University Press, Evanston 2001.
Malaparte C., *Kaputt*, Adelphi, Milan 2009.
Maldonado T., *Il futuro della modernità*, Feltrinelli, Milan 1987.
Manzini E., *La materia dell'invenzione*, Arcadia, Milan 1986.
Munari B., *Artista e designer*, Laterza, Rome-Bari 1971.
Sacchetti V., *Il design in tasca*, Editrice Compositori, Bologna 2010.

The '60s were characterised by a boom in plastics, which ended up replacing the more common and widespread Cellophane.

"It was in the research centres of Moplefan in Terni, in collaboration with machine manufacturers, that works first began for the production of a packaging film that could replace the more costly, but certainly more widespread Cellophane. The downstream world of conversion and use was very resistant to change, also because the Cellophane production chain was already in the hands of large multinational firms less than willing to promote change, clearly interested in protecting their own assets. It was therefore decided to install a printing department so as to be able to contact food industries directly, and promote the new PP-based film."

Maurizio De Costanzo

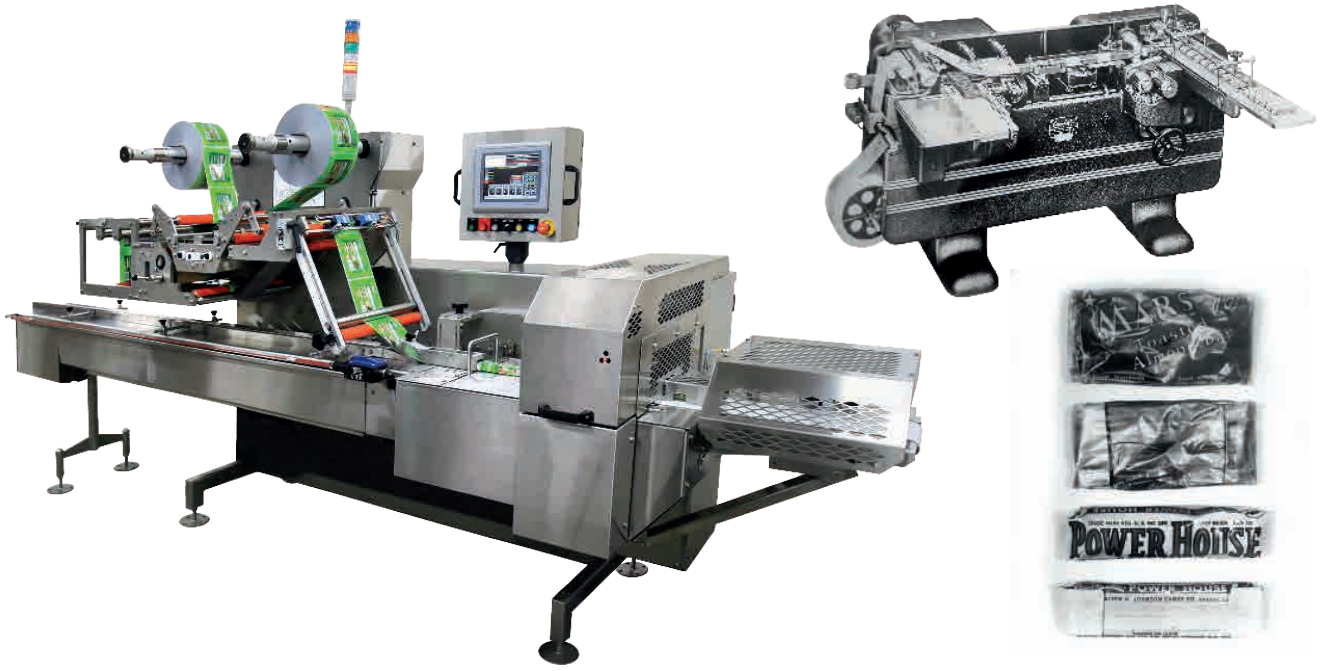
Consultant, DECOM S.r.l.

Maurizio De Costanzo, chemical engineer, has worked in the plastics and flexible packaging film (PE, PP, PET, PA) industry for more than 40 years in executive positions for companies such as Mobil, Montedison, Exxonmobil, Shell, Snia, and is currently a member of the General Council of Federchimica and the Board of Directors of Plastics Europe Italia. He offers strategic consultancy in the plastics sector through his company, DECOM.

75 years of manufacturing horizontal flow wrappers

Campbell Wrapper Corporation

www.campbellwrapper.com



In 1910, David Hudson and Alexander Sharp purchased a small machine shop in Green Bay (Wisconsin, USA) that manufactured parts for sawmills and repaired steamboats, and named it The Hudson-Sharp Machine Company. The general manager, Sam Campbell, was called to serve in the United States military in the Second World War: while he was deployed in Europe, he was introduced to wrapped food products. After his return, he developed a machine to automate the packaging of food items: with a team of engineers, he invented the horizontal flow wrapper and filed a patent application in 1946. The "Campbell Wrapper" was quickly adopted throughout the world for the wrapping of candy, chocolates, cracker, and various other products: the patent was granted shortly thereafter for the machine design. The early flow wrapping materials were paper, glassine, and Cellophane. In 1947 Campbell and a few close associates purchased the company and continued to develop flow wrappers for vacuum packaging.

In 1956, FMC Corporation acquired the company and kept upgrading the flow wrapper product line with inverted, dual lane, shrink and polyethylene wrappers. Wrapping materials evolved: polypropylene replaced cellophane, due to its lower cost, longer shelf life and lower melting point.

In 1994, FMC sold the flow wrapper product line to SASIB. In 2001, John Dykema purchased the flowpack product line from SASIB and called the company Campbell Wrapper Corporation. The sanitary and hygienic design of the equipment was significantly improved to ensure food and medical/pharma product integrity. The business continues to design and develop new products and integrates the latest electronic control technology. Nowadays, Campbell develops machines to run recyclable content, paper, and other sustainable film structures.

For this contribution, thanks to Michael Jarmuskiewicz for giving voice to Campbell Wrapper Corporation.

Flow wrap packaging arrives in Italy

Cavanna Packaging Group

www.cavanna.com

Founded in Prato Sesia (Novara, Italy) in 1960 thanks to the intuition of Mario Cavanna, who, while working as a freelancer for the Pavesi Group, came face to face with the first flow wrapping machines used for crackers, produced by the US manufacturer Campbell, immediately recognising the importance of food wrapping. In the '60s, with the rapid spread of large-scale distribution, packaging became essential, and the company took its first steps with its first flow wrappers. The search was on for materials able to replace Cellophane, among which polypropylene, invented by Nobel Prize winner, Natta, and developed on Cavanna flow wrappers. In the '70s and '80s, Cavanna went from being a producer of machinery to a producer of automated plants, whose feeding systems were a priority: this process was boosted by the use of the highest performing materials, which also satisfied the challenging market demands. Cavanna became a protagonist. From the '80s through to the year 2000, with the stabilisation of electronics, Cavanna became one of the world producers of automated primary wrapping lines, and presented the Cartesio Division to supply both Robotics and Secondary packaging. In the early 2000s, the Test Laboratory (now TESTCLAB) was created to test materials and study their interaction with flow wrappers. The first sustainable materials were adopted (paper, PLA, compostable films based on cellulose and starch), and relationships were formed with material producers and converters: as general knowledge of materials improved, the machine-material twosome became indispensable. New markets emerged, from pharmaceuticals to baby and healthy food: wrapping needed to guarantee product safety, and flow wrap packaging perfectly satisfied these demands. Service was created as an independent business unit to guarantee increasingly better service to clients throughout the world, and with the Revamping program, outdated automated lines were updated with new electronics. Today, the still family-run Group boasts 300 employees who work from a total of 4 facilities located in Italy, Brazil, and the USA.

Our thanks go to Amedeo Caccia Dominioni and Miriana Brigo, who in drafting this paper gave a voice to Cavanna Packaging Group.

Towards automatic and digitalized flow wrappers

Syntegon Technology

www.syntegon.com

Syntegon (headquartered in Waiblingen, Germany) is a world leading machine manufacturer of horizontal flow wrappers, covering the entire range of applications from entry-level to fully automated systems including services. It's current position in the horizontal flow wrapping market unites the expertise from Doboy, Tevopharm and SIG which started in 1906.

In the late 1930's products were packed in Cellophane bags poorly sealed with heated flat irons. Two Doboy millwrights developed a rotating sealing unit to solve this problem: in the 1940's Doboy began producing the sealing machines. In 1956-57 SIG caused a sensation with the first continuously running horizontal flow-wrap machine equipped with a main motor and all functions were mechanically coupled through gears.

In the 1970's the introduction of plastic films like BOPP required more accurate temperature controls. Registered printed packaging material required more sophisticated drive controls. Simultaneously the introduction of the PLC allowed a simplification of many control tasks, eliminating the electro mechanical relay components.

At Interpack 1990 Tevopharm launched the Pack 1000, the first servo controlled horizontal flow-wrapper, shortly followed by SIG's HSM in 1992. The new technologies of axis controls and synchronous motors increased the flexibility and the speed of the machines and improved the ease of changeovers.

At the turn of 2000 increased labor cost and higher demand were driving the industry to higher speeds. In 2011 the HRM was presented, the first HFFS machine that can splice at film speeds up to 150 m/min.

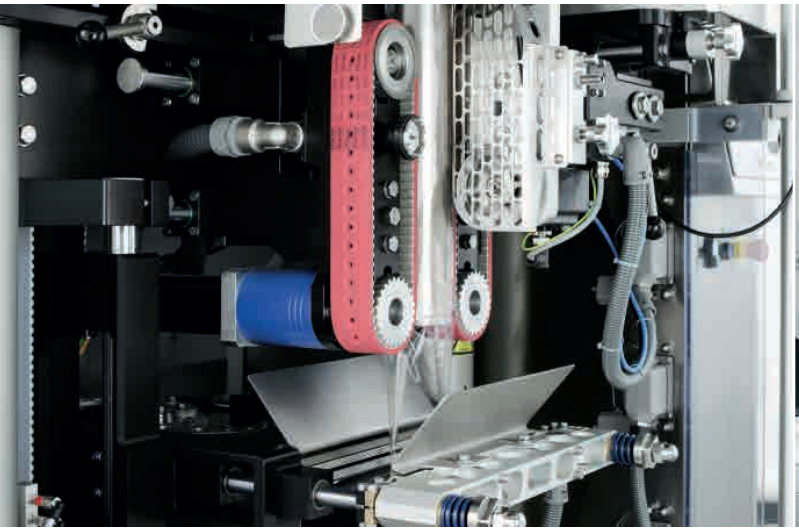
Automation, sustainability and digitalization are among the most important trends in our industry today. The retrofittable and patented paper-ON-form forming shoulder allows running paper film at the same speed as conventional plastic film. The integration of smart functions like predictive maintenance and self-optimization will be the next major change to flow wrapping equipment.

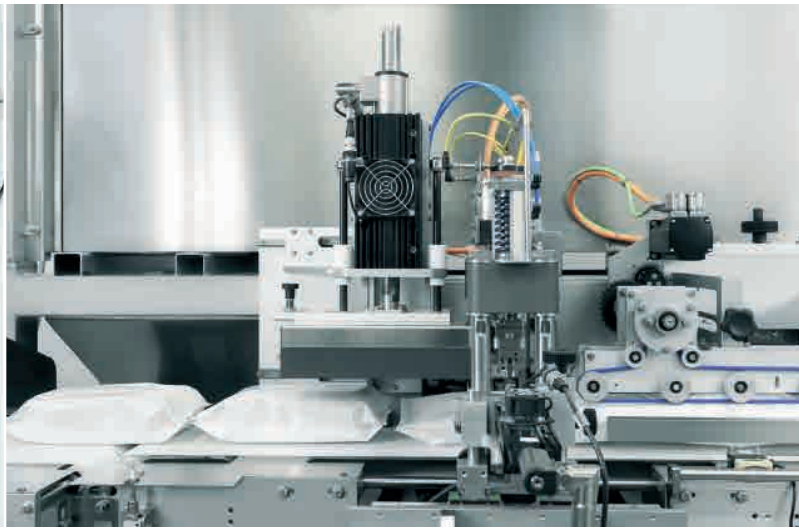
Thanks to Stephan Schuele e Bruno Oberle for the story of the company.

Automatic machines and complete lines for flexible packaging

IMA FLX HUB

www.ima.it





Founded in 1961, I.M.A. Industria Macchine Automatiche S.p.A. is a worldwide leader in the design and manufacturing of automatic machines for the processing and packaging of pharmaceutical, cosmetic and food products. A leadership gained through investments in R&D, constant dialogue with end-users, and IMA's ability to internationalise and conquer new markets. In 60 years in business, IMA has built up experience, reliability, and an extensive presence in the global market. Starting from 2013, with the acquisition of the Ilapak Group's companies, IMA moved its first step giving birth to today's FLX HUB: a one stop supplier for flexible packaging solutions.

With the aim to strengthen and confirm all-round competences with a world-wide perspective, IMA achieved the acquisition of other two Italian historic brands - Eurosicma and Record, and the Argentinian Tecmar.

IMA FLX delivers turn-key horizontal and vertical solutions from weighing systems up to any end of line equipment. Thanks to continuous investment in R&D and to IMA Open Lab support, IMA FLX HUB can offer packaging solutions specially designed to run new eco-friendly wrapping materials such as paper, recyclable and compostable films.

At IMA Open Lab - a network of technological laboratories and testing area dedicated to the research on sustainable materials, technologies and production optimization processes - several services can be provided, from the material analysis to optimize performances (or fix issues), to customized testing sessions with dedicated team: 360° consulting, possibility to identify best material to achieve customer production goals, material performance evaluation to get the perfect match between machine & flexible film.

For the writing of this contribution we thank Klaus Peters and Paola Dalla Casa for giving voice to the IMA FLX HUB group.

Did you know that this paper-plastic film can be peeled for easier recycling?

Sbucciapack

by **Ottavia Burello**, Short-Term Research Fellow, DAD – Department of Architecture and Design, Politecnico di Torino

Sbucciapack is a Packaging produced by Lineapack, composed of two materials coupled using biodegradable water-based glue, which are easy to separate: the outer layer is made from paper (40/50 g brown paper), and the internal layer in a thermoplastic material (polypropylene or polyethylene; the plastic is selected depending on the content to guarantee the barrier protections most suited to the use).
The system reduces the amount of plastic film used (polypropylene or polyethylene) by up to 70% with respect to standard packaging, and allows the two layers to be manually separated. This in turn gives rise to a spontaneous and intuitive new gesture, sensitising and stimulating the end user to improve the quality of their recycling, more actively engaging them in this stage of the product's life cycle. Moreover, Sbucciapack can be customised with flexo printing and eco-friendly water-based inks. The film can be supplied in reels or in preformed bags.

Bruno Munari, an icon of 20th-century Italian design, prompted us to reflect on how Nature had created the perfect packaging, such as the peel of an orange or the pod of a pea, in terms of opening systems, sensoriality, and accessibility of contents. This reflection will be further explored with the help and guidance of Marco Bozzola, who will focus on the interaction and usability of flexible packaging, and of flow wrapping in particular, breaking down now almost instinctive actions into their specific design components.

Interaction and usability in flexible packaging design

by **Marco Bozzola**, Associate Professor of Design, Department of Architecture and Design, Politecnico di Torino

The value of packaging

Packaging is a service product, that is, it has an essential function of supporting contents, in order that they can be channelled into the market, protected against tampering and deterioration, communicated, easily and correctly used. A somewhat trivial but essential premise in order to understand the nature and value of packaging: a service-product halfway between a utility and communication function, but also a process-product that embodies all stages of the design and development of a product's packaging (Kotler et al., 2005).

Packaging is created in the knowledge that it has an ephemeral life but with high performance standards and a variety of functions necessary for the commercial success of the product it is designed to enhance. An apparently second-rate product expected to do a lot with very little: few materials, reduced costs, a low environmental impact, maximum production efficiency, extreme lightness.

Flow wrapping and flexible packaging films in general meet said requirements of reduction and optimisation even more so than other types: a very thin film that wraps around the product at a minimum ratio in weight compared to the contents, thus reducing the impact on the environment, limiting bulk for logistics, providing a large surface area for communication and guaranteeing the hermetic protection of the contents.

The product for sale is therefore equipped with a second skin, which in perceptive terms becomes part of the product itself, often even contributing to its use, for example as a stain-proof grip when eating a chocolate bar.

Packaging, behaviour and lifestyles

Packaging has forever followed behavioural and lifestyle trends with the aim of satisfying the consumer's needs, perspectives and ways of consuming or using the product. This aspect is particularly evident in flow wrap packaging: snacks consumed on the go for example, or products intended for consumption away from domestic contexts, but strictly linked to movement.

In these scenarios, the function of packaging in determining the portion, that is, in holding a predefined

quantity of product corresponding to the unit of consumption, and therefore of sale, finds its natural vocation in flow wrapping. A snack bar or single-serve sugar packet for your coffee at the bar represents a specific experience, already implicitly told by the product packaged in that specific format and quantity: communication can certainly contribute to reinforcing the message already expressed by the container itself.

A relationship is therefore established between the quantity, configuration and moment of consumption, which always defines the product's identity: from the design of the system of actions and gestures it generates, to the prompting of specific social behaviours (Bucchetti, 2015).

Usability, accessibility, inclusion

As regards the utility function, the packaging design is called to observe the user's needs arising from expected behaviour, or potentially implemented by the target during consumption. Behaviour, actions, habits that generate gestures and ways of using the product, which the packaging must interpret through its configuration. **The handling, positioning of the grip, method and point of opening are some of the aspects that good packaging must guarantee and communicate in a simple and intuitive way, in line with the user's abilities.**

When speaking of usability, it is important to talk not only of the specific target, but also in a broader sense of anybody who may come into contact with the product: the target itself may include very different users (albeit belonging to the same market segment) in terms of their physical and cognitive capacities. It is therefore good practice for the design to focus on parties with differing abilities and on the resulting specific interaction needs.

In this sense, usability is expressed in the principle of accessibility that needs to be guaranteed by the packaging, facilitating not only use of the product, but also guiding it in the direction of maximum inclusion of all potentially interested parties.

Accessibility is in fact included among the 10 fundamental values of packaging in the Ethical Packaging Charter, drawn up by Giovanni Baule and Valeria Bucchetti in 2015, specifying the importance of equal fruition for users with different capacities. Packaging is therefore ac-

cessible if it is equally usable by parties with different skill sets, knowledge, but also personal backgrounds: considering, therefore, any sensory limits (whether permanent or temporary), but also purely subjective characteristics such as attention span, right-handed or left-handed users, previous experiences, the conditions of the context (Baule and Bucchetti, 2015).

One therefore also speaks of "cultural accessibility", that is, the formulation of solutions that help overcome socio-cultural barriers defined by communication codes that are often self-referential and associated with a dominant culture, which generate a sense of inadequacy in users foreign to that system of values. This acceptation of accessibility, which is more difficult to identify and therefore more insidious, continues to be largely neglected with respect to others (Miglietta, 2020).

One of the critical aspects in evaluating the accessibility of packaging is its opening performance, which can sometimes even translate into negative or frustrating experiences in situations where the packaging creates an obstacle to accessing the product (generating so-called packaging frustration). This is today a pressing issue in packaging design, where flow wrapping and flexible packaging in general (e.g. sachets, bags, stand up pouches) is carefully studied to identify solutions able to improve the ways and techniques of accessing the contents.

The typical flow wrap opening, whereby the longitudinal closure flap is used as the gripping point to make the tear, is on one hand an instinctive method and therefore one with good affordance, but on the other presents several limitations in terms of the agility of the gesture and control over the result.

Previous page: Graphics for Sugarillos single-serve sugar packets, where the quantity of the contents are effectively and poetically represented. Design mousegraphics

Greater precision is obtained using additional tools, such as scissors: the horizontal cut is certainly the cleanest and in some cases also lends itself to reclosability, however the gesture may be less immediate for certain categories of users such as the elderly or people with joint problems.

Another intuitive opening method is the end seal zig-zag cut, which also serves as an invitation to tear the film. Here it is interesting to see how the technical solution influences the utility function, which can in turn determine the feedback on the technical solution: for example by opting for a more or less wide and evident zig-zag cut, we are able to improve the comprehensibility of the packaging in terms of its functionality (opening and access) and narrative (production and technologies).

In any case, all solutions developed during the design phase must take into account the need for mediation between product protection needs (a reliable seal, characteristics of the material) and in-use performance in terms of easy opening. The design action therefore needs to efficiently interface with the technical and technological requirements, as well as the needs of the parties involved in the different stages of the process.

To this end, easy open systems can facilitate the product access experience. The slit opening with invitation (knoch), for example, allows a clean-cut opening with a simple and rapid gesture, which can be further improved, using colour to make the tear point more evident. Graphic communication in fact plays a decisive role in understanding use: even a simple line (like the ones used in single-serve sauce and condiment packets), which indicate the opening point and tear direction, can be key.

The tear strip opening (longitudinal or transversal), highlighted by a contrasting colour, is another type able to simplify the operation, exploiting the nature of the film which effortlessly opens when slit. The "unrolling" gesture

which accompanies the action is a starting ritual and part of the act of consumption.

There are also spontaneous practices that characterise how flow wrapping is opened, actions that are not necessarily planned a priori, but which have almost become a ritual. This is the case for the pop opening action, whereby the compression exerted on the wrapping by the user produces playful behaviour and gestures, which culminate in the cracking sound of the seal that breaks. We could also mention certain packaged snacks in which this type of opening is ideal for children who welcome this gesture with amusement.

In other cases, the opening system itself is able to identify a specific brand or product, connoted as an identity-making action through a method of use embedded in the imaginary. This is precisely the case for Ritter Sport's KnickPack system, where we could say the gesture was designed even before the technical solution itself: by simply bending the packaging along the dotted line, with a symmetrical gesture by both hands, the food is immediately accessed, already broken. An opening that responds to a spontaneous gesture and recalls scenarios of sociality and positive values such as sharing (breaking bread) and friendship.

There are also open and close systems suited to situations in which consumption or use of the product is diluted over time, making it possible to preserve the freshness and integrity of the contents. These systems require agile and intuitive gestures (adhesive labels, zips, rigid covers) able to guarantee sealing performance intended to restore, at least in part, the hermetic capacity of the flow wrap packaging.

For example, the zip just below the cutting line or adhesive labels used to make sure wet wipes stay moist between uses. In both these systems, the function of the packaging is strictly linked to the quality of the product it contains (Badalucco, 2011), that is, it ensures correct preservation.

If facilitating access to the product means eliminating physical and cognitive obstacles that would otherwise

make the packaging difficult or unpleasant to use, the importance of the packaging's graphic-visual design is clear. The latter is aimed at creating user awareness regarding the product's identity, making its underlying values recognisable while at the same time communicating useful information in order to understand and properly use the packaging.

Symbols and colours, the choice and spatial composition of which must appear consistent with the brand's identity, and at the same time evocative for the target market. Colours and contrasts able to make the product recognisable even for the visually impaired, and similarly the legibility of the text (choice of font, size, treatment) which must not be considered an optional and simply slotted in to the limited available space. The graphic design therefore has the task of mediating between the different needs of the various parties (first and foremost the brand and consumer): packaging that is legible and therefore comprehensible will also be more willingly welcomed by the consumer, who will prefer it to less clear alternatives.

If we then consider the roughly 253 million people throughout the world with visual disabilities, of which 85% are visually impaired (about 2 million in Italy) (ANS, 2021), it is clear that communication which covers a broad spectrum of needs corresponds to a more effective, but also fairer commercial offer. Given this scenario, and considering severe visual impairment or blindness in particular, packaging systems today include Braille labelling systems, but the technical constraints associated with their positioning on smaller products continues to limit their full implementation (Capitani, 2020).

The sense of sight is certainly the most immediate in providing useful information in order to understand the product and make it perceivable even in the point of sale, but it is certainly not the only one. In flow wrap packaging, the variety of possible finishes on the outer side of the film adds an additional level of communication to the non-verbal narrative established between the packaging and the consumer. A clear, glossy film conveys freshness and hygiene, while a matt finish creates a silky effect to the touch. Soft and neutral colours on the other hand can trigger assonance with the sphere of body care and beauty (for example, certain emollient soap bars where the packaging already "speaks" the language of the contents); similarly, a textured pulp finish on the outer side, perhaps in kraft paper bonded to a polymeric film, suggests naturalness and craftsmanship. In these cases, in addition to looking at the product, touching the paper with our fingers and even hearing the sound it makes, are both very evocatively powerful elements in synaesthetic terms. Triggering the user's multisensory capacities therefore guarantees a more complete and satisfying buyer and user experience.

The theme of accessibility is therefore in everyone's interests and no longer strictly linked to the physical sphere (the inclusion of people with disabilities or sensory limitations), but, as mentioned, also the cultural sphere (inclusion of ethnic groups, geographical origins, religious beliefs) and social sphere (gender inclusion, social class). A concept which therefore expands its borders, taking into account the multiple and stratified dimensions of globalised society, providing equipment and services for different sensibilities (Laureano, 2018); packaging itself, insofar as a communicative tool integrated into society, today acknowledges the need to further develop this focus, striving for a new form of sustainability in support not only of major environmental objectives, but also less prominent ones such as equity and inclusion.

Sources

ANS Associazione Nazionale Subvedenti, "Ciechi e ipovedenti: quanti sono?", *Descrivedendo*, 20th December 2021 (https://bit.ly/3pP03S5).

Badalucco L., *Il Buon Packaging*, Edizioni Dativo, Milan 2011.

Baule G., Bucchetti V., *Carta Etica del Packaging*, Edizioni Dativo, Milan 2015.

Bucchetti V., *Packaging design: storia, linguaggi*, progetto, Franco Angeli, Milan 2015.

Capitani L., "Packaging Frustration free", Print Lovers, 82, 20th December 2021 (https://bit.ly/3IYKgYe).

Kotler P. (et al.), *Principles of Marketing*, 4th European edition, Pearson Education Limited, London 2005.

Laureano P., "Accessibilità, interpretazione e fruizione dei siti UNESCO nella evoluzione della concezione del Patrimonio rispetto alle nuove dimensioni sociali multi culturali", Cetorelli G., Guido M. R. (edited by), *Il patrimonio culturale per tutti. Fruibilità, riconoscibilità, accessibilità*, Mibact Direzione Generale Musei, Rome 2018.

Miglietta A. M., "Accessibilità culturale nei musei. Barriere e strategie di miglioramento", Museologia Scientifica Memorie, 21, 2020.

Since the '50s, the role of packaging has changed and transformed in response to the new needs of society and its evolving consumer habits

"In the late '50s, during the Italian economic boom, we witnessed the emergence of supermarkets: different companies from different sectors found themselves needing to sell and present their products also through packaging, while also ensuring protection of the contents. This new scenario required more protective packaging and increasingly stronger seals in order to enhance the shelf life of the displayed product. The packaging needed to guarantee a better seal and speak for itself."

Ludovico Rangoni Machiavelli

Former Sales Director and Partner, Thermosac S.p.A.

Thermosac S.p.A., founded in 1956 in Cassino (FR, Italy), was a producer of flexible multi-materials and a broad range of industrial packaging for food, pharmaceutical, tobacco, and military products. It was one of the few converting companies located south of Rome in those years.

Food and packaging: an inseparable twosome

Barilla Group

www.barillagroup.com

The Barilla Group was founded in 1877 by Pietro Barilla, as a bakery in Parma (Italy). Its history has been characterised by continuous and progressive growth, with strong development in the '50s, a subsequent complex internal restructuring and continuous international expansion. In 1954, the cracker, an evolution of the military biscuit as a substitute for bread, debuted on the Italian market all the way from the US thanks to Mario Pavesi, and soon became the flagship product of another company, Pavesi, in Novara.

In the '60s, the first flow wrap packaging line was installed at Pavesi for Pavesini biscuits. Even for back then, it was a very advanced, mainly mechanical line, with limited electronics and an analogue interface. The concept of pocket-size packaging, within reach, in single rations, was therefore introduced, and widely diffused also through advertising: a new strength with which to emerge in a changing society. Barilla took over Pavesi in 1994, becoming the largest group in Italy for oven-baked products. Today, more than 2,000,000 tons of Barilla products accompany millions of people during times of consumption all throughout the day, thanks to distribution in more than 100 countries, and a workforce of 8,500 employees in more than 30 production sites. The products are the result of a collaboration with more than 1,200 suppliers, and more than 800 raw materials.

Barilla observes and studies the world to contribute to the evolution of society and of communities, creating a dialogue with the main constituents of the supply chain, drawing inspiration from new generations, ques-

tioning the efficacy of technologies. Nowadays a product needs to be good, but must also contribute to a balanced lifestyle, and packaging is a prime example.

This commitment is demonstrated by its participation in multi-stakeholder round tables and its adhesion to international initiatives (e.g. Ceflex "The Circular Economy for Flexible Packaging" in EU or the "Sustainable Packaging Coalition" in the USA). 99.6% of packaging materials used today (mainly paper and cardboard, plastics and glass) are designed to be recyclable, and 100% of packaging includes instructions for the end user regarding its disposal. Moreover, for years, Barilla has been committed to purchasing raw materials with a view to reducing environmental impacts and contributing to territorial well-being.

In validation of this approach, the group has long adopted a Sustainable Agriculture Code, and has taken a stance on Animal Welfare and Principles for Sustainable Packaging, all based on the principles and logics of responsible supply chain management. The full application of said principles opens up to new challenges with the aim of using packaging materials obtained exclusively from renewable and/or recycled sources in the future.

Our thanks go to Paolo Barilla, Antonio Copercini, Giovanni Ballerini, Luigi Ganazzoli, Francesca Amalfitano, Julia Schwoerer, Valentina Masotti, Giorgio Marazzi, Luca Ruini and Roberto Pagliari, who in drafting this paper gave a voice to the Barilla Group.

Did you know that it is a translucent paper that comes from the northern forests?

Sylvicta

by **Ottavia Burello**, Short-Term Research Fellow, DAD – Department of Architecture and Design, Politecnico di Torino

Sylvicta, a paper made with wood pulp fibres, is produced by Arjowiggins: its name is derived from the Latin *sylva* (forest) and *invicta*, invincible, but also the historic emblem of the county of Kent, where the Chartham Mill is located, where paper has been produced since 1730. Made from pure cellulose with only renewable raw materials and without any additives, it has a higher oxygen, odour, and grease barrier, thus preserving the quality of foods and improving their shelf life. These characteristics offer excellent support to converters, with additional properties for humidity, cold sealing, heat sealing, or the use of glues. It is certified for contact with fresh, dry, frozen, wet, and fatty foods with the possibility for monomaterial, recyclable, compostable (industrial and domestic), and biodegradable packaging in accordance with the highest market standards. Its natural transparency makes it possible to see the contents. Thanks to the application of heat-sealable coatings, it is available in different forms with weights from 42 up to 180: bags, pouches, flow wrapping, metallised versions, stand-up bags, and labels. It is suitable for various printing techniques and traditional finishes such as offset and flexo printing, embossing, hot stamping, and die cutting.

Materials, technologies, and packaging have evolved in a parallel, or in any case strictly consequential manner: material and technological changes have led to the development of innovative concepts in the packaging sector, and, vice versa, increasingly challenging packaging needs have driven producers of packaging materials and machinery to change, and progress. Sara Limbo explores these aspects in a paper dedicated precisely to technological-material evolutions in the packaging sector, with a particular focus on those concerning flow wrapping.

Flow wrapping: materials and technologies, between the past and future

by **Sara Limbo**, Associate Professor in Food Packaging and Shelf Life, Department of Food, Environmental and Nutritional Sciences, Università degli Studi di Milano Statale

Automated wrapping and packaging

The automated in-line packaging of food products using flexible packaging (flow wrapping) was initially introduced in the Fifties and Sixties with the aim of speeding up the production chain during the packaging stage, and guaranteeing a longer product shelf life, thus also facilitating product distribution.

It was an innovative concept for those years: **filling a bag with food at the same time as it was made, to then hermetically seal it in-line, represented a modern concept of packaging**, made possible thanks to the simultaneous development of increasingly thinner and more versatile plastic materials, and the possibility to combine them with other materials such as paper and aluminium foil. The potential offered by this type of packaging system was immediately interpreted as an innovative competition strategy and way of leading the food industry towards an important economic and social transition. Within a few years, the automated flow wrap packaging machinery sector had also been established in Italy, which rapidly became one of the countries most recognised – not only in economic terms – for the high value and reliability of the technologies it had developed and produced. The progressively broader adoption of flow wrap packaging systems also contributed to flexible packaging being affirmed as a complete and versatile solution able to ensure the protection and preservation of different types of food products, allowing capillary distribution in compliance with safety and hygiene requirements, in a new perspective placing the consumer and their needs at the centre.

This relationship between packaging materials and systems was progressively consolidated, to the point where today, the food industry, together with the packaging materials and technology industry, find themselves facing new challenges ranging from the environment to food waste reduction along the entire supply chain, and including opportunities offered by the digital transition.

The flow wrap packaging sector, perhaps more so than others, will be the key player in this important evolution that will support new forms of distributing food, and non-food, and which will guide the consumer towards greater awareness of their role in the dynamics of sustainability.

Flexible packaging and flow wrapping technology

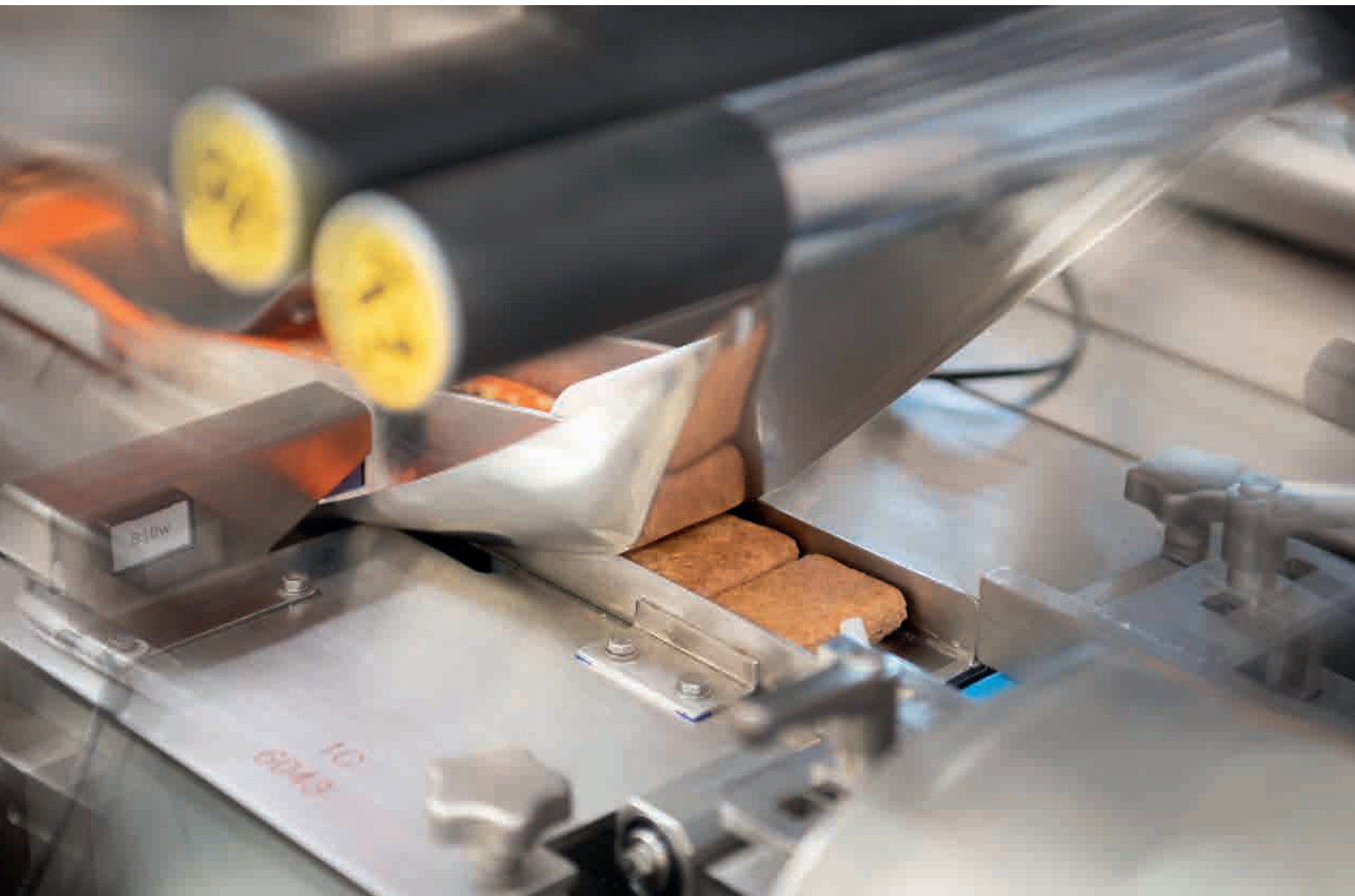
Flexible packaging is a highly versatile packaging solution. It consists in using single- or multilayer plastic film, or else thin multilayer composite materials (multilayer composite materials: materials obtained by combining multiple different materials, normally plastic films coupled with thin cellulose sheets and/or aluminium and/or with coated or metallised plastic films, using suitable bonding techniques, for the purpose of improving the physical properties of the final structure. They are also known as laminate, polylaminate or multi-material multilayer structures) having a certain degree of mechanical flexibility allowing their transformation into containers on automated packaging machines.

The resulting packaging, after being filled with food and hermetically sealed, is able to adapt to the shape of its contents, but, thanks to the properties of the material used to make it, will also be able to contract and expand its volume by modifying the atmosphere inside the packaging itself. This packaging is mainly used in the form of bags with three or four seals, wrappings, in different configurations for single- or multi-serve packs.

One of the many recognised advantages of flow wrapping is the reduced weight of the packaging, which translates into lower transport and distribution costs; thanks to this feature, despite being one of the most popular solutions in the food industry (this type of container represents more than 40% of packaging), flow wrapping represents only 10% of the total weight of food packaging. (GIFLEX, 2021).

It is precisely in its capacity to protect and preserve that flexible packaging differs from other types. Thanks to its lightweight materials with increasingly optimised thickness, flexible packaging represents a discreet interface between the product and the environment, offering modular protection in accordance with the specific needs of the packaged product and its distribution cycle. The materials used to make flexible packaging are designed to control the transfer of gas and vapours through the packaging, the passage of light radiation, etc., thus reducing the likelihood of the product being subjected to any unwelcome alterations throughout its shelf life.

The flexibility of the packaging can help reduce the mechanical stresses, while the hermetic nature of the seals offers protection against undesired or fraudulent tamper-



ing. Thanks to the functions of containment, quality preservation, and safety, flexible packaging has therefore become one of the essential tools in managing food waste.

The development of flexible packaging starting from reel-wound materials requires a synchronised set of forming, filling, and sealing actions, made possible using automated equipment known as Form-Fill-Seal (FFS) machinery, which can be integrated in the production process of the content itself. These systems are commonly classified into horizontal (HFFS) or vertical (VFFS) machines, depending on how they are developed, but are also more simply known as flow wrappers.

The term is derived from the special way the material is unwound from the reel, and then fed by means of mobile guides towards a forming tube, where it is shaped into a tube around the filling line, all in a continuous flow on the machine, before wrapping or containing the food product (Yam, 2009).

Vertical FFS machines are generally used for "unsorted" food products such as liquids, granular products, powders or small pieces that can be handled using pumps or pneumatic systems.

The typical form of packaging obtained is the so-called pillow-pouch, but the system also allows the formation of bags with three or four seals. The material automatically unwound by the reel is formed into a tube by being dragged onto the forming tube, which is specifically shaped for the type of packaging to be developed and the type of material used. The tube forming stage is followed by rapid longitudinal and transversal sealing operations before filling with the product.

The transversal seal must support the packaged product, making it important to properly manage the times, sealing, and cooling temperatures in order to ensure the effective hermetic seal of the final packaging. In the longitudinal feed cycle, the bag being formed is filled with the product and transversally sealed by a cutting device, before being released by the machine. For more sensitive products (for example coffee, nuts, snacks, salads, etc.), VFFS machines are configured for modified atmosphere packaging.

Horizontal FFS machines on the other hand are designed for solid products, with a regular form, which can be arranged in a specific order; the versatility of these systems allows them to be used in a broader range of applications, and even for more complex foods, creating final packaging in the most varied shapes. For example, the version allowing trays or containers to be sealed inside the flexible packaging can hold any type of product. In these systems, the film automatically unwound from the reel is fed towards the forming tube, which thanks to its special design, allows the formation of a plastic tube around the filling line along which the product flows. The tube is then longitudinally sealed on the upper or lower side of the machine at the same time as filling.

The entire cycle ends with two transversal seals made using intermittent or continuous operating systems, which are based on different operating principles depending on the material used, requested speed, or characteristics of the product being packaged. For temperature-sensitive products such as ice creams, materials can be used with cold sealing systems, and longitudinal and transversal sealing systems based almost exclusively on the exertion of pressure on the flaps of the material to be joined. (Piergiovanni and Limbo, 2010) Other heat or ultrasonic sealing systems are largely used in these types of automated packaging machines.

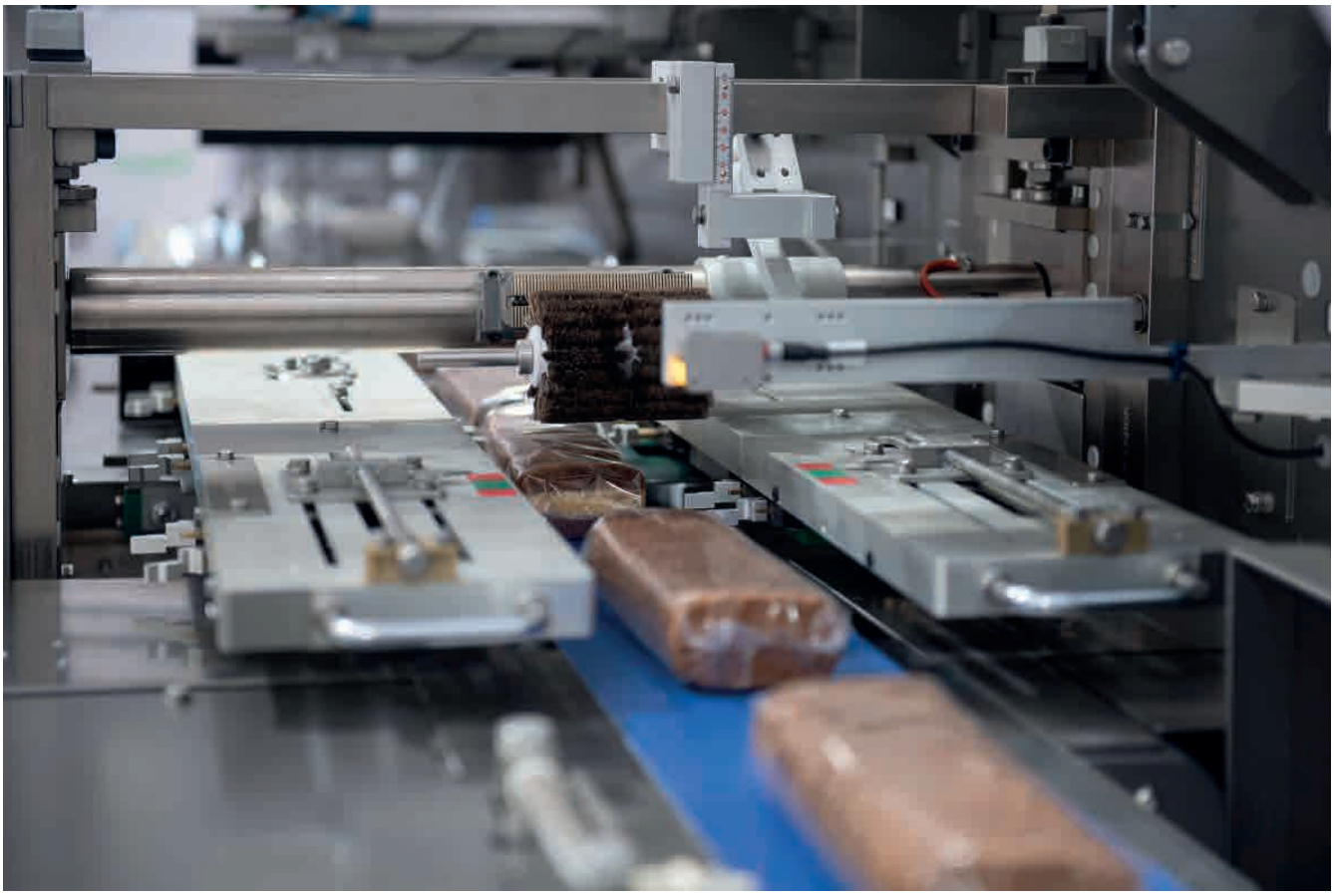
Even horizontal machines can be combined with other operations, for example modified atmosphere filling using gas flushing techniques. In this case, by means of a lance positioned in correspondence with the tube being formed, the air in contact with the product is replaced by a selected atmosphere. The air is thus gradually diluted in order to eliminate the atmospheric oxygen inside the packaging. Granular or porous products make it more difficult to remove the air from the packaging, and the sealing time will therefore need to be lengthened in order to ensure more efficient modification of the atmosphere.

The versatility of horizontal flow wrap packaging machines also allows the development of compensated vacuum modified atmosphere packaging. In this case, the atmosphere is introduced to the packaging only after creating a vacuum in the bag, in a dedicated station of the machine. Operation is intermittent to allow enough time to create the vacuum and compensate it with the selected atmosphere for the specific food product.

Another complement to horizontal flow wrap packaging is represented by the heat-shrink station positioned at the machine output. The sealed bags enter a hot air tunnel where the film is heat-shrunk, perfectly adhering to the product.

The new challenges of flow wrap packaging

Flow wrapping machines and systems are largely used in food companies thanks to their adaptability to existing systems, different processing volumes, numerous types of



loading and automation, and different types of foods that can be packaged and conditioned. The current and complex issues being faced by the food packaging industry require continued research and innovation by producers of flow wrap packaging machinery, thus ensuring the sustainability of the entire system. As already mentioned, automated packaging machines have enjoyed great success thanks to their excellent compatibility with predominantly flexible packaging materials. As the concept of environmental sustainability continues to gain strength, packaging materials have found themselves at the centre of a genuine revolution in their design and subsequent development. In this context, the studies and industry efforts of the packaging sector are focused on identifying packaging solutions which are recyclable or processable for recycling within a short period.

This is an important challenge accompanied by the need for access to alternative materials with respect to common structures, also using renewable sources where possible, or the processing waste of agricultural or food products that do not compete with primary food production. The push towards the adoption of recyclable and/or compostable packaging is also due to the many European programs and regulations now covering the subject, which, in recent years, have set ambitious objectives in relation to reducing the environmental impact of packaging materials.

The development of increasingly recyclable and sustainable packaging structures, however, requires an important contribution by companies that produce and use packaging systems, in order that the lines can be adapted to the new materials. Monomaterial plastics, thin composite structures made from compostable paper and film, represent some of the categories most able to satisfy circular economy criteria, which may nonetheless need to have specific functional properties (such as "machinability", sealability, sealing strength) in order for them to be transformed into flexible packaging.

The response to system sustainability can therefore be improved not only by modifying the structures of materials or reducing their thickness, but also by optimising new solutions that are integrable and integrated into the packaging machines. Integrable because the complete replacement of a packaging system for one that satisfies the needs of innovative materials would require a significant

and not very sustainable economic investment for a food company; the possibility to modify a packaging line, on the other hand, would significantly reduce the necessary investment, offering continuity and versatility.

The use of new materials may also require additional actions on the forming unit and sealing strength systems, but the sealing operation is without a doubt the most critical. Monomaterials often consist in an outer layer more sensitive to temperature compared to composite films, with the risk of creating seals with defective strength. Sealing and ultrasonic systems that longitudinally seal the molecules constituting the packaging film by means of mechanical vibration as opposed to heat, allow a reduction in the quantity of material used to wrap the products, in addition to using less energy. Last but not least, the optimisation of the packaging/packaging machine system, in terms of the necessary shelf life of every single product, must also be considered in terms of so-called "food security", that is, guaranteed access to the food by the greatest possible number of people, thus avoiding waste along the supply chain. (Baule and Bucchetti, 2015) Suffice it to think that flow wrap packaging systems are selected as an investment in the food companies of developing countries.

This example similarly highlights how the possibility to obtain hermetically packaged products with a guarantee of high quality, safety, and shelf life, allows the packaging machinery sector to be structured towards objectives of accessible and sustainable food production, in a multidisciplinary and multidimensional approach that takes into account the complex economic, environmental, and social perspectives.

Sources

Baule G., Bucchetti V., *Carta Etica del Packaging*, Edizioni Dativo Srl, Milan 2015.

GIFLEX. "Piano Nazionale di Ripresa e Resilienza. Le proposte del settore Imballaggio Flessibile", 2021 (https://bit.ly/3MDOuqs).

Piergiovanni L., Limbo S., *Food Packaging. Materiali, tecnologie e qualità degli alimenti*, Springer Verlag, Milan 2010.

Yam L. K., *The Wiley Encyclopedia of Packaging Technology*, 3rd Edition. Wiley & Sons, Inc., Hoboken 2009.

1. The flagship structure of the Wrapping Materials Team is the "TESTCLAB" Test Laboratory, where new materials are tested to check their seal or reduce the cutting strip.

2. Spring Jaws: these were jaws allowing a superficial spring.

3. HP Jaws: jaws that allowed a constant operating temperature across the entire front, a very important aspect for certain recyclable plastic films not particularly resistant to temperatures.

4. Green Kit: special "custom-made" mechanics necessary to allow the use of certain materials such as paper and compostable films.

By the late '90s, Cavanna had understood that in order to design packaging machines, thorough knowledge of wrapping materials was essential. Thus began an in-depth study to improve the machines themselves and offer an increasingly complete service to its clients.

"Along the way we came across the first sustainable films, which we started working and experimenting with, and we realised that they needed a different approach in the sealing area. The first ultrasonic attempts were made, thanks to which we won a Packaging Oscar in 2006. In the years that followed, the TESTCLAB[1] laboratory continued its research, working and experimenting with the "Spring Jaws"[2], "HP Jaws"[3], and on the Green Kit[4]. There is still much to be done, we are facing an important challenge, and one thing is for sure, we're never bored!"

Amedeo Caccia Dominioni
Senior Consultant, TCO Consulting

TCO Consulting is a business unit of the Cavanna Packaging Group that deals with packaging design, and which studies interactions between machines and materials, focusing on sustainable, recyclable, and compostable films.

Consumers, products, and packaging in contemporary large-scale retail

Coop Italia

www.e-coop.it

In 1947, the Alleanza Italiana Cooperative di Consumo (AICC, Italian Alliance of Consumer Cooperatives) was officially founded, later becoming Coop Italia. It was shortly after the Second World War, and Italy had just begun its slow reconstruction. In this context, cooperatives were able to guarantee savings by bypassing wholesaler intermediation, taking advantage of that age-old experience, which at the dawn of the Unification of Italy, in 1854, had already given rise to the first "Social Security Warehouse" in Turin. From 1947 onwards, the cooperative consumer movement became progressively more structured: in 1955 the National Association of Consumer Cooperatives was established, between 1967 and 1969, the Coop Italia national consortium was created, and from 1968, Coop's turnover began to grow, with expansion into the non-food sector from 1979. To this day, the Coop mission continues to be that of providing its members with quality products at affordable, but fair and sustainable prices, and in particular, to respond to growing, quickly evolving needs.

Throughout its entire history, Coop has always supported its cooperative shareholders and consumers in their daily needs. With the increasing complexity of purchasing dynamics, the Coop structure changed too, albeit maintaining its cornerstone of good food at the right price, of a healthy sold product, allowing the correct remuneration of its producers and suppliers, at largely affordable prices for Italians. At an asynchronous pace with respect to the international context, Coop has made innovation and company process management the two linchpins of its success. The '50s saw the birth of new structures with a view to modernising its outlets, and in 1963 the first supercoop (the name

given to the first large supermarkets of the cooperative movement) was opened, Coop 1 in Reggio. The '60s were dedicated to re-organising the cooperatives as a business system, specialising in large-scale retail in the national sphere and with a unified image: the consumer-product relationship had changed and was now established without any mediation by the seller. In this context, new types of packaging were developed also for single-serve products in clear wrapping, the first flow wrap packaging.

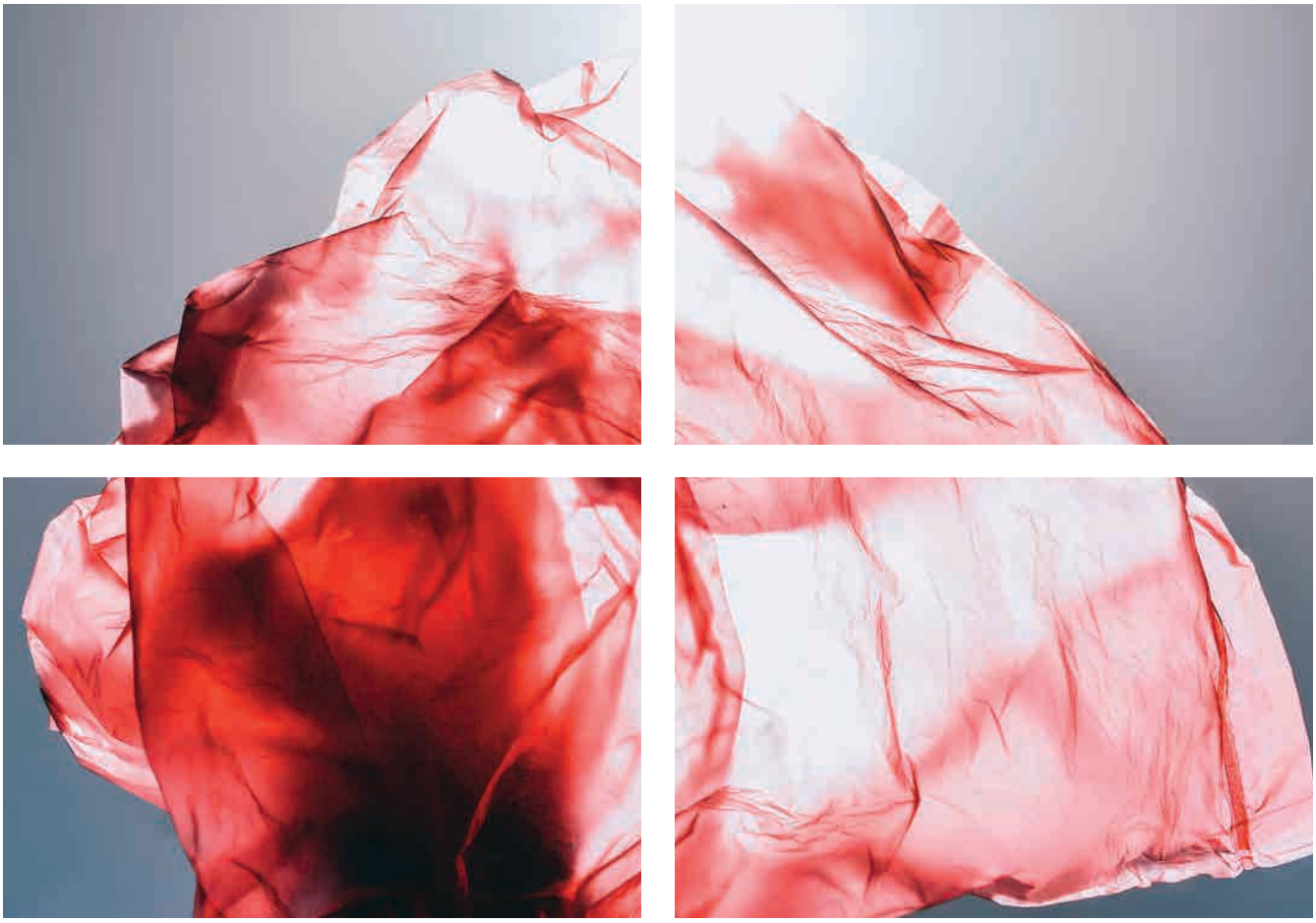
The ability to interpret the needs of Italians in a forward-looking key gave Coop a genuine edge, which in the '80s led towards a reflection on the product in terms of packaging. In 1986, Coop had already developed a campaign encouraging families not to abandon packaging in the environment, marking the start of the more complex process of disposal. Coop's focus on the environment continued to grow, culminating in 2019 with its adhesion to the European Commission's pledging campaign and to the Circular Plastic Alliance, in addition to its subscription to the European Code of Conduct for responsible commercial and marketing practices in 2021. A focus on sustainability that has now lasted 4 decades, and which has led to the redefinition of packaging, also through communication which informs of necessary actions, and educates not to waste, but to imagine a new life.

Our thanks go to Silvia Mastagni and Rosita Fattore, who in drafting this paper gave a voice to Coop Italia.

Did you know that corporate partnerships are a strategy for sustainability?

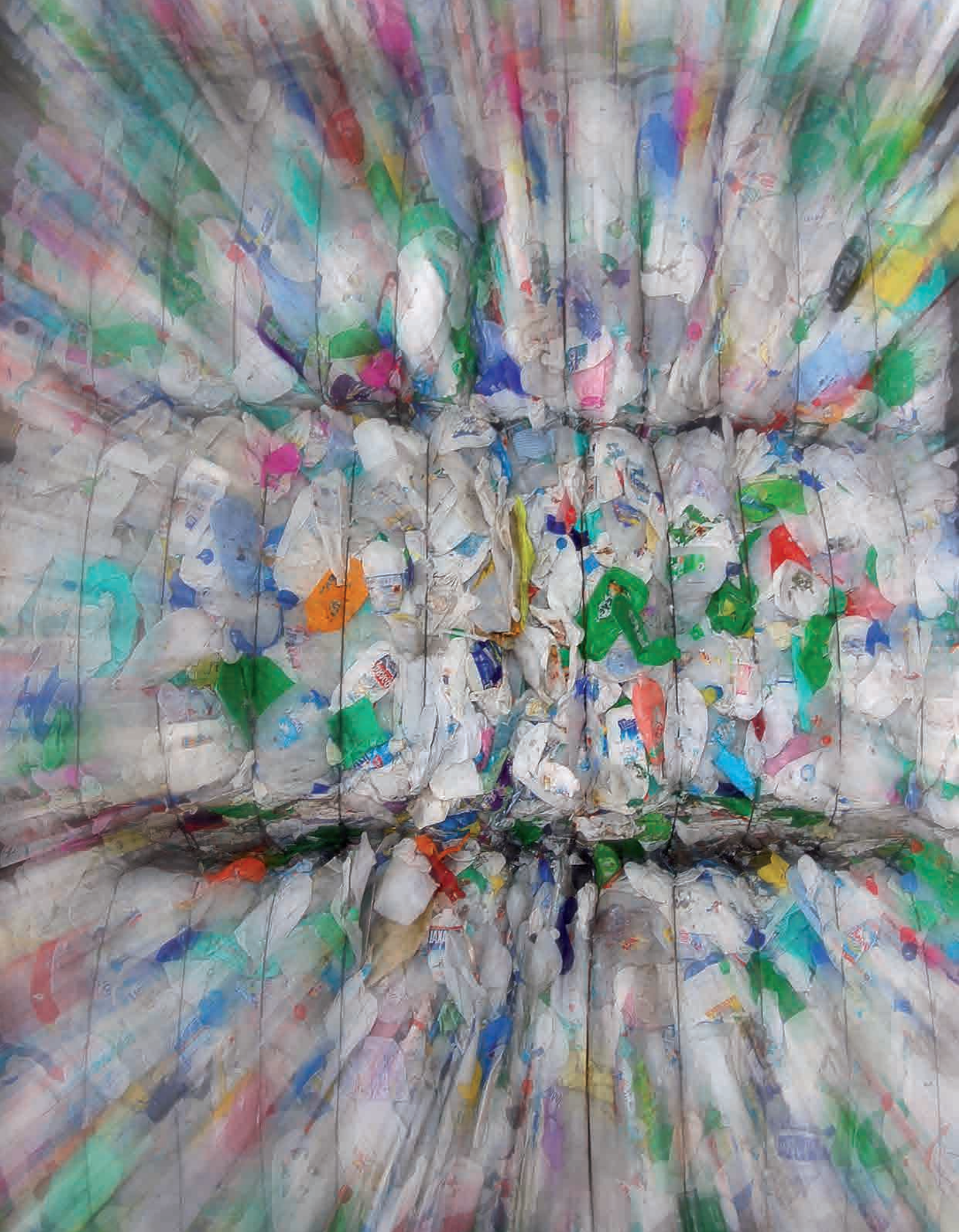
Project Kit Kat

by **Ottavia Burello**, Short-Term Research Fellow, DAD – Department of Architecture and Design, Politecnico di Torino



Nestlé Oceania, in response to the global push for circular management of flexible packaging waste, launched "Project Kit Kat" to develop recycled flow wrap packaging for Kit Kats, one of the most iconic and widely recognised confectionery lines in the world. The project involved the collaboration of multiple partners in the flexible packaging supply chain, with the aim of creating a genuinely circular value chain of flexible plastic packaging waste. The participating companies, CurbCycle, iQ Renew, Licella, Viva Energy Australia, LyondellBasell, REDcycle, Taghleef Industries, and Amcor, worked in synergy to create (flow wrap) packaging for Kit Kats with 30% recycled content.

Project Kit Kat, presented at the "Wrap on Soft Plastics" event, represented an important step towards the circularity of plastics and flow wrap packaging, and a springboard to fill the infrastructural and government policy voids, with a feasibility study for the necessary investments, technical, economic, and environmental advantages of a high-tech recycling industry, to be subsequently extended to all territories.



Today, the sustainability debate is manifested in society on multiple levels: from street demonstrations, to industry, to new policies. More and more frequently, themes of sustainability and plastics are grouped together in whirlwind discussions that only disorientate and distract from the issue. Guided by Paola Scarfato, Annalisa Apicella, and Loredana Incarnato, we delve into this world, enlightened by the knowledgeable insight and approach of science, seeking to reflect on that which Chris DeArmitt defined a "plastic paradox".

Plastics: eco-sustainability and innovation

by **Paola Scarfato**, Associate Professor of Materials Science and Technology, Department of Industrial Engineering – Università degli Studi di Salerno
Annalisa Apicella, Postdoctoral Research Fellow of Materials Science and Technology, Department of Industrial Engineering – Università degli Studi di Salerno
Loredana Incarnato, Full Professor of Materials Science and Technology, Department of Industrial Engineering – Università degli Studi di Salerno

The contemporary challenge of plastics

In recent years, growing interest in ecological problems has led scientific and industrial research towards the development of new materials and new processes representing genuinely eco-sustainable solutions.

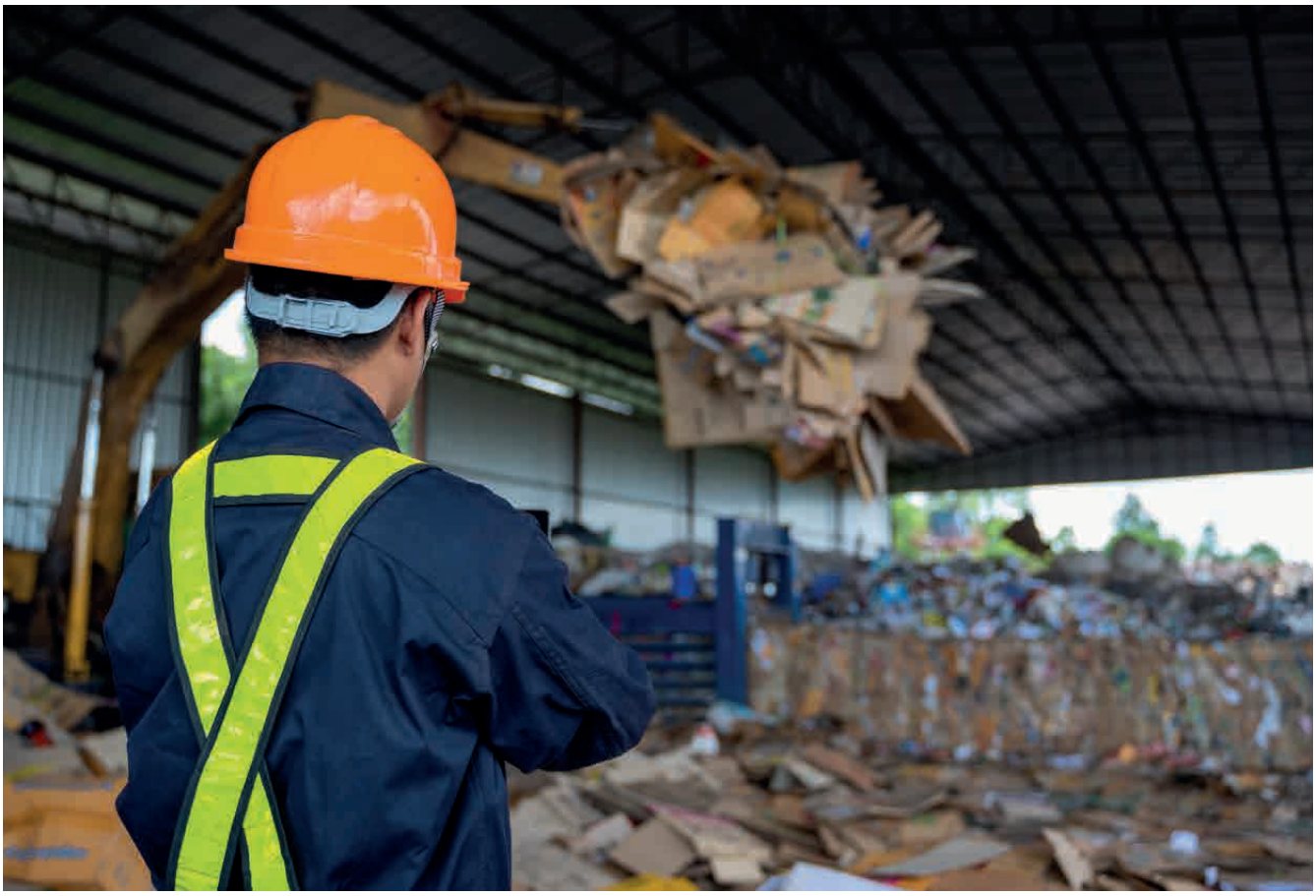
The packaging sector, including flexible films and rigid containers, represents the largest single market for plastic consumption. In Europe, about 62 million tons of plastic are produced each year; of these, 23 million tons are used to produce packaging (92 million tons expected in 2050), representing more than 40% of the total weight of all plastic inserted in the market, and more than 60% of the fraction of post-consumer plastics (PlasticsEurope, 2021).

In particular, following a predominantly (or exclusively) disposable type of use, 40% ends up in landfills, corresponding to 9 million tons of waste destined to accumulate in the soil. 32% escapes collection and sorting systems and eventually ends up in the ground or oceans. Less than 30% of produced waste is collected for recycling. According to estimates, the economy loses about 95% of the market value of post-consumer plastics (or between 70 and 105 billion Euros per year) (Ellen MacArthur Foundation, 2016). The packaging industry has therefore recently been identified as a key sector in addressing the challenge of global sustainability.

Measuring the sustainability of packaging

This focus on the environment has naturally also affected consumption, to the point where it has become a genuine driver of choice: this is what emerged from the third edition of the Large Consumption Packaging Observatory held by Nomisma in collaboration with SpinLife-Università di Padova, to explore the role of packaging in the purchasing choices of consumers. According to this study, 75% of consumers prefer to buy from producers who choose raw materials of natural origin and sustainable packaging (Nomisma, 2021).

Paper and glass are the materials perceived as the most respectful of the environment. In reality, glass production actually requires more kg of CO_2 compared to other types, while the paper production cycle is the one



that wastes the most water. The consumer, therefore, is mindful of the environment but is poorly informed about the materials making up the packaging and their sustainability.

In order to assert the sustainability of a packaging, the life cycle needs to be analysed using the LCA (Life-Cycle Assessment) methodology, which considers every element of a product's development: raw materials, energy, waste, by-products, transport, disposal, etc. It illustrates what price the environment has to pay for each specific product.

Often, **the least considered aspect of sustainability is the impact of food waste. In this respect, plastic packaging reduces food waste by up to 33%, extending the shelf life of packaged products and guaranteeing quality and safety.** The use of energy, and the number of resources required to produce a food, can easily and significantly exceed those generated by the production of the plastic packaging used to protect it: in other words, plastic packaging helps save more resources than it uses (Verghese et al., 2015)

Innovation and sustainability of materials for Flow Wrapping: monomaterial, biodegradable, and paper-based solutions

In the context of sustainable packaging, scientific and industrial research has focused on the development of innovative solutions in terms of materials and processes, with a multidisciplinary approach. Technological innovation and sustainability thus become an inseparable twosome, based on an integrated approach. While on one hand the development of new eco-sustainable packaging promotes the use of raw materials from renewable and/or recycled sources, the reduction of thickness and weight, the development of 100% monomaterial packaging and the transition from plastic packaging to mostly paper/plastic packaging, on the other it also makes use of innovative technologies, such as nanotechnologies, active packaging, coatings, the optimisation of orientation techniques, able to give the packaging all the functions it needs.

Looking at flow wrapping in detail, the functional requirements a material must satisfy in order to be used with Form Fill Seal (FFS) technology include (Morris, 2017):

- Seal strength/hot tack strength;
- Stiffness/ductility balance;
- Friction properties;
- Barrier properties.

This traditionally implies the use of heterogeneous multilayer structures based on: PET/PE; PS, a material par excellence in the dairy sector due to its physical-mechanical characteristics and excellent processability; BOPP with a fast seal coating on one side and high barrier PVdC-based lacquering on the other; regenerated cellulose coated on both sides with PVdC and metallised on one side. These highly engineered materials possess numerous functional properties – efficiently protecting the food and prolonging its shelf-life – but their heterogeneous composition makes them very difficult to dispose of.

The development of new monomaterial multilayer structures, able to provide the requested performance using a single polymer, are a valid strategy in significantly simplifying sorting and recycling activities during the post-consumer collection stage. Careful designs and optimised systems generally opt for the use of polymers such as PE, PP, PET; using suitable orientation techniques or the deposition of high barrier monomaterial coatings, they are able to give the packaging functional characteristics comparable or superior to standard multi-material bonding (sealability, visual and mechanical properties, O_2 and aqueous vapour barrier), guaranteeing a lower impact on the environment thanks to their reduced thickness and possibility for recycling.

Recent innovations in this sector have also led to the market availability of biodegradable and/or compostable materials, even though for certain technologies, the latter do not guarantee performance levels comparable to traditional ones. In some cases, paper can be used to flow wrap dry products (such as cereals and legumes), and, with hermetic sealing and barrier layers, can also provide suitable protection against O_2 and aqueous vapour for products with a high fat content (such as nuts and coffee). However, its application is limited by several poor intrinsic properties, making it necessary to adopt more delicate and slower processes to avoid creases and tears, with ad hoc combinations of time, temperature, and pressure during sealing, and the replacement of the bag forming sets with a gentler infeed angle (≤ 27°).

European strategy for end-of-life management of plastic packaging

From a legislative point of view, in 2018 the EU Commission adopted the "European strategy for plastics in a circular economy" (COM/2018/028), which identifies plastics as a priority area and promotes sustainability along the entire value chain: from primary producers to converters, from brand owners and retailers to waste collectors and recyclers. The EU strategy's most ambitious target is that by 2030, 100% of plastic packaging inserted on the EU market, including biobased and biodegradable packaging, will be designed to be reusable and recyclable. Added to this are the various initiatives of companies and associations. In December 2018, the Circular Plastics Alliance was launched to bring the EU recycled plastics market up to 10 million tons by the year 2025.

The Alliance includes the entire plastics value chain with more than 175 industrial, academic, and public organisations. In 2020 the CEFLEX (Circular Economy for Flexible Packaging) platform, which brings together more than 160 European companies, associations, and organisations, published the Designing for a Circular Economy (D4ACE) guidelines (CEFLEX, 2020), with the aim of making all flexible packaging within Europe circular by 2025. With a focus on polyolefins (monomaterial in PE and PP and PE/PP structures), which account for 80% of the market, the document provides recommendations on key elements of packaging such as materials, barrier layers and coatings, size and form, ink and adhesives.

Mechanical and chemical recycling processes for cyclical packaging

Plastics recycling is dominated by mechanical recycling, i.e. those processes whereby plastics, after being sorted according to their polymer type and colour, are molten, obtaining a secondary raw material with characteristics similar to those of virgin polymer, which can then be reprocessed using conventional production processes for plastic products. Plastics recycling is mainly "open" recy-

cling, because it doesn't always produce the original product, but rather a different one, depending on the type of recycled polymer, its physical-mechanical characteristics, and compliance with specific regulations.

Mechanical recycling technologies alone, despite being well consolidated, are not sufficient to achieve the targets set by the European Commission for the plastics industry, because plastic gradually reduces its properties as it is progressively recycled. In some cases, therefore, the quality of post-consumer plastics is too poor, because they are degraded or contaminated, or not separable from one another, and their processing provides secondary raw materials of poor technological and commercial value.

These limitations are sparking a growing interest in various chemical plastic recycling processes. Said processes make it possible to convert, decompose, or purify the plastic into its starting constituents (monomers) or oil, which can then be purified and reused as high-quality raw materials.

Even though their environmental impact is not known, and their efficiency is never 100%, theoretically speaking, chemical recycling can be infinitely repeated. Examples of good sustainable practices initiated by major plastics converters (Foschi and Bonoli, 2019) include Coca Cola and BASF, which have invested in chemical recycling, while Trinseo, in collaboration with Fernholz, has released a new grade of polystyrene containing 40% PS obtained from chemical recycling (r-PS) for flow wrapping applications intended for the dairy sector (Packmedia.net, 2020).

AMB and Bandera will be building two new extrusion plants intended for the production of recycled PET (r-PET) film for thermoforming and FFS (Form-Fill-Seal)

(Polimerica, 2021a). Bio-One and Nestlé have partnered with Danimer Scientific to replace PET with PHA in bottle manufacturing, while Unilever is collaborating with Bio-on for the microplastic PHA in bio cosmetics. Saica Flex has developed a monomaterial laminate bag that can contain more than 50% post-consumer polyethylene, successfully tested on FFS lines for single-serve detergents (Polimerica, 2021b).

Renewed awareness

The study of materials and their life cycle is a key factor in facing the challenge of global sustainability, based on awareness rather than rhetoric and perceptions.

It is truly difficult to imagine a world without plastic: a material that has always offered performance levels unattainable by others, which for this reason must be considered a complement to the range of materials able to accompany technological progress.

Nonetheless, it cannot be denied that the use and management of post-consumer plastic waste is still fraught with problems, in part technical, and in part tied to poor consumer education. All this means that these materials, at the end of their life, are considered merely as waste and not a resource, with significant repercussions on the environment.

The importance acquired by the theme of sustainable plastics has, in recent years, promoted and stimulated the growth of ecological awareness, which has now permeated every stage of designing new packaging with a reduced environmental impact, of which flow wrapping is an example.

Sources

CEFLEX, "Designing for a Circular Economy' (D4ACE) guidelines". 21st February 2022. https://guidelines.ceflex.eu/guidelines/

COM/2018/028 Communication by the Commission to the European Parliament, to the Council, to the European Economic and Social Committee, and to the Committee of the Regions. European strategy for plastics in a circular economy, 16th January 2018.

Directive 2009/125/EC of the European Parliament and of the Council, regarding the establishment of a framework for the development of specifications for the eco-design of energy-related products, 21st October 2009.

Ellen MacArthur Foundation, "The New Plastics Economy: Rethinking the Future of Plastics", 2016 (https://bit.ly/3MEBZuP).

Foschi E., Bonoli, A., "The Commitment of Packaging Industry in the Framework of the European Strategy for Plastics in a Circular Economy", Administrative Sciences 9, 18 February 2019.

Morris B.A., *The Science and Technology of Flexible Packaging*, Elsevier Inc., Amsterdam 2017.

Nomisma, "Osservatorio Packaging del Largo Consumo. Consumer Survey", February 2021.

Packmedia.net, "Post-consumer recycled polystyrene: the new proposal from Trinseo and Fernholz", 24th September 2020 (https://bit.ly/3hPZItN).

PlasticsEurope, "Plastics – the Facts 2021", 21st February 2022 (https://bit.ly/3Kh1Asm).

Polimerica 2021a, "Linee Bandera per AMB. Saranno installate in Italia e nel Regno Unito per produrre rPET destinato a termoformatura e FFS", 4th October 2021. https://www.polimerica.it/articolo.asp?id=26582.

Polimerica 2021b, "Buste in PE per metà da riciclo. Saica Flex ha sviluppato una busta laminata monomateriale che può contenere oltre il 50% di polietilene post-consumo", 18th March 2021 (https://bit.ly/3IWQ3xN).

Verghese K., Lewis H., Lockrey S., Williams H., "Packaging's Role in Minimizing Food Loss and Waste Across the Supply Chain", *Packaging Technology and Science*, 28 April 2015.


still
water

From the production of packaging materials, to the consumers of the packaged products, through to the disposal of the packaging itself, all parties in the supply chain are protagonists of sustainable development.

"On a national level, we always seem to think we're at the tail-end of environmental protection and management, the negative things always make better headlines. The latest Eurostat data shows Italy as the highest ranking European country for recycled packaging waste per capita. Our perception is far removed from the data we need to communicate, to push ourselves to keep doing better during each stage of the packaging life cycle: from the production of the materials, to their application, to their end-of-life management, working in synergy and virtuously!"

Simona Fontana

Head of CONAI Circular Economy Research Centre

The national packaging consortium, CONAI (COnsorzio NAzionale Imballaggi), is a private non-profit consortium. It boasts roughly 700,000 members, all producers or users of packaging. It was established further to the Ronchi Decree of 1997.

Secondary raw materials: a second life for plastic packaging

Montello Group

www.montello-spa.it

The year 1996 marked a turning point for the Sancinelli family. It was the year of conversion from the industrial production of steel for reinforced concrete, to one of the first centres for the manual sorting of post-consumer plastic packaging. The world's first automated plastic waste sorting system was installed in 2000. Within less than a year, it would allow the production of the first kilogram of R-PET (recycled PET), taking yet another step towards the Circular Economy. Just two years later, production began of polyolefin granules obtained from recycled post-consumer flexible plastic packaging.

The Montello mission is to maximise the value of both plastic and organic waste, with its high-level specialisation in this sector, in order to manage more than 1,000,000 tons of waste per year, of which approximately 700,000 tons of recycled organic waste (OFMSW), and 300,000 tons of recycled plastic packaging, equivalent to the annual production of about 10.5 million inhabitants (in Italy).

Low-density polyethylene and polypropylene are obtained from recycled flexible packaging and are processed and transformed into polyolefin granules producing about 120,000 tons/year: through sorting, shredding, washing, drying and extrusion, they are then converted into granules, obtaining a 100% recycled material, which is a mix of polypropylene and polyethylene, usable for new productions of artifacts.

In the complex network of players involved in the packaging supply chain, the final stages dedicated to collection and recycling allow the combination of apparently

very different actions, such as those of individual citizens and compliance with strict laws and regulations during the recycling process, in order to achieve the production of high-quality secondary raw materials able to be re-inserted in production cycles.

Recycling therefore represents a fundamental link in the value chain: Montello confirms this by recycling plastic waste every day, maintaining its properties using systems with a high technological level, in order to achieve the best possible product from its recycling, for both foreign and Italian companies.

In order to create a Circular Economy, priority must be afforded to a policy grounded on design strategies based on principles of reduction and reuse: for many plastics, which cannot be reused, which are still absolutely necessary, increased recycling will prove essential in keeping the materials and material value in circulation within the system and in reducing the quantity of plastic delivered to landfills, incinerated, or disseminated in nature.

The design of a recyclable mono-polymer packaging is therefore fundamental. For that packaging where it is essential to combine more materials for the purpose of greater performance we must try to minimize as much as possible the impact of the good life.

Our thanks go to Francesca Sancinelli and Rodolfo Cattoi for this contribution.

The new challenges of flexible packaging

by **Beatrice Lerma** and **Doriana Dal Palù**, Assistant Professors in Design, DAD - Department of Architecture and Design, Politecnico di Torino
with **Riccardo Cavanna**, President of UCIMA – Unione Costruttori Italiani Macchine Automatiche per il Confezionamento e l'Imballaggio (Italian Automated Packaging Machine Manufacturers' Union) for the 2022-2024 period

In light of that revealed thus far regarding the complex relations surrounding the theme of Flow Wrap Packaging and Sustainability, it is worth focusing on several essential aspects before drawing any final conclusions. As has already emerged in the main sections of this paper, the main aim of packaging, as well as its essential function, is to bring the contents it contains from the producer to the end consumer, in the best possible conditions. Over the years, this has involved a progressive process of improvement aimed at enhancing performance, until eventually achieving – in the flow wrap packaging we know today – an unexpectedly high level of technology, engineering, reliability, and durability, such as to make an apparently simple bag able to preserve an otherwise perishable food or medicine, in the most extreme conditions for even years.

This said, it is legitimate to ask ourselves at this point what type of future can be imagined – or aspired to – for a technology as currently evolved and apparently "resolved" as this.

This section therefore consists in a collection of paragraphs, each reflecting on a number of challenges that flow wrap packaging is set to face in the short, medium and long term, posing questions arising from the drafting of this paper, to which in some cases an answer has been sought, tracing out a path based on the considerations made thus far, and which in other cases are re-proposed with new open questions. The only remaining question is whether flow wrap packaging will make it to Mars. Actually no, it will have already been by the time you finish reading.

QUESTION #1: What are the possible scenarios for flow wrap packaging in the coming decades?

The current period is proving to be particularly critical in terms of the procurement and availability of raw materials. The recent rise in the cost of materials used in the packaging sector, such as aluminium, paper, and biopolymers is generating a certain degree of turbulence in the raw materials market, as is the rising cost of energy needed to convert the contents and containers. What effect will these fluctuations have on the world of packaging, and flow wrap packaging in particular?

Flexible film, whether obtained from renewable or non-renewable materials, is the basis of flow wrap packaging. The great preference currently being afforded to paper (and cardboard)

in the packaging sector, also encouraged by policies introduced to control the use of plastic packaging and disposable products, is obviously contributing to the increase in the price of raw materials. It would not be surprising if the pressure generated by the recent and elevated quantity of paper in waste centres were to cause difficulties in the short-term linked to this material's re-insertion in the production cycle. On the other hand, while cellulose-based materials might be running scarce, despite having a much more consolidated production chain, bioplastics and their promise of a "lighter" approach are relatively new and therefore have not yet been fully optimised to meet the necessary performance levels of packaging (e.g. machinability, sealability, strength, impermeability). Moreover, they often prove to be economically unsustainable and not always available in terms of the supply needed to satisfy the intense market demand.

The situation is therefore very complex, and the role of traditional polymers (both virgin and secondary) continues to be the most feasible solution today, despite being the least preferred by end consumers.

QUESTION #2:
What are the standpoints of end consumers (and others) that flow wrap packaging will need to address?

We know that today's youth are among the most conscious ever about the issue of sustainability. When we think of sustainability, the most obvious association is with environmental sustainability. Yet there are other forms of sustainability, which are often underestimated, from the economic to the social sphere, which are in turn linked to other connected topics (e.g. responsible use of resources, the capacity to generate income and work, security, health, justice, wealth), each contributing to a proper analysis of the various aspects.

Apart from a general interest in sustainability itself, at this historic moment in time there are also additional phenomena, which tend to have the effect of shifting the focus, creating widespread concern, underlying apprehension, or, in some cases, a complete rejection of that which could presumably threaten sustainability itself. In this context it is of utmost importance, in order to genuinely influence the result, to focus efforts in the right direction, and not to waste energy chasing new demons and presumed culprits.

It is therefore conceivable that, not only today's consumers, but also those of tomorrow will be extremely attentive to the sustainability of packaging, raising more and more often reasonable doubts regarding the origin of the raw materials, the correct disposal of packaging, and its entire life cycle. Efficiently catering to these demands, which are of equal concern to all, from film producers to packaging machine producers, requires a response by the supply chain, enlightened by knowledgeable scientific insight, but that's not all. Of crucial importance in this scenario is the need to educate the end consumer, who are themselves the driving force of the demand for sustainability, and the keystone of value enhancement – in the true sense of the term – for the materials currently in circulation, thus limiting further exploitation of any known resources.

QUESTION #3:
How important is it to educate end consumers for the purposes of environmental sustainability?

The extraordinary properties of plastic have today been "clouded" by its faults: but what actions can the end consumer take to feel "guilt-free"?

Abandoned packaging on the desert dunes of Oman is the result of an action by a person, who, whether due to thoughtlessness or carelessness, left it in the environment. Each of our actions, insofar as designers and producers, but also end consumers, has a reaction: teaching end users from a young age to know and recognise materials and types of products that have reached the end of their (potentially first) life, which we therefore consider waste, is one of the most important steps towards their proper recovery and disposal.

Teaching good habits, and therefore also correct waste management, means providing information about the path of a product once it becomes waste: Where do I throw it? What happens in waste centres? How is packaging treated when we throw it in recycling bins? A predominantly paper, polylaminate material, which combines paper on the outside with plastic on the inside, can in some cases be processed in the paper recycling chain: but how is it treated? And what happens if we throw it in the non-recyclable bin?

Many doubts on the part of consumers, but also those who design or commission new packaging, concern biodegradable and/or compostable polymers[1]: materials more recently introduced to the market, which don't yet have a globally recognised identity and expressiveness. And it is similarly unclear where they need to be thrown and how they are modified (in the environment and in waste centres). Incorrectly disposing of a compostable material in the plastics chain, can in fact often pollute the entire recycling chain. On the other hand, these materials are still difficult to recognise and distinguish by sight, touch, and sound, with respect to polymers of fossil origin.

1 European legislation sets out that a compostable material must decompose by at least 90% within 3 months, and biodegradable materials within 6 months. And that's not all: it must be possible to convert the compostable material into compost at the end of the industrial disposal process. Biodegradable materials on the other hand, are defined as such to the extent that they are degraded by natural physical agents in water, carbon dioxide, or methane.

Markings and labels help and guide our choices, opening up to a new reflection on the need to strive for the most consistent information and types of treatments, even in recycling centres; the latter, in fact, often adopt different disposal procedures, creating doubts in end consumers, which one hopes can be minimised.

QUESTION #4:
How do we overcome the circular economy challenge?

Today, there are essentially two scenarios for the post-consumer recycling of polymeric packaging.

On one hand, we have the more consolidated mechanical recycling process, which is based on the separation (or sorting) of waste intended for recycling. This process, which is already highly efficient for plastics, could benefit – for its further optimisation in the future – from a push towards monomaterials. This would mean, in the case of flow wrap packaging for example, and as was partly attempted with drink bottles, concentrating the choice of materials on a narrow selection of alternatives common to all producers. It goes without saying that this type of operation would not be possible without suitable mediation between the trade associations and manufacturing unions. However, it would be relatively difficult to find an agreement between producers, not to mention the presumable flattening of competitive elements, which in this case would be shifted from the theme of processable materials to, for example, the thickness of the film, packaging speed, sealing strength, etc.

On the other hand, expectations are growing in relation to the chemical recycling process, a technology which is still in the development and optimisation stages, representing a hope yet to be materialised, and which, put very simply, consists in the decomposition of polymeric waste into basic chemical substances, including monomers for the production of new plastics that can be directly used in food contact (unlike plastics derived from mechanical recycling). This would allow the recycling process to be implemented also for polymeric waste with a particularly consistent "non-polymeric" fraction, unable to be mechanically separated. In any case, it is important to remember what has already been done, and what is still being done to contain said types of waste. One example is the reduced use of polylaminates in the packaging sector, and especially in flow wrap packaging, now limited to cases in which this technology is truly indispensable.

Add to this, paper packaging made from post-consumer waste – today overwhelmingly proposed as a valid alternative to plastic packaging in the flow wrapping sector – which is already technologically consolidated thanks to pulping systems. Particularly important in this case is the definition of recycling based on the percentage of paper with respect to "non-paper", which can affect the performance of the film wrapper in terms of machinability and quality of sealing.

What the flow wrap packaging sector (and others) are calling for, together with the scientific community in this twofold scenario, is for LCA methods to be used as much as possible in order to evaluate the actual sustainability of packaging, and for the same circularity sought for waste to also be applied at a decisional level, involving all stakeholders on all levels, including institutions, in order that policies can benefit from the precious information that each link in the chain is able to provide.

QUESTION #5:
What role will institutions play in mediating between policy and business?

The complexity of the issues raised requires a considerable effort in order that the chorus of different voices are able to establish a functional dialogue, able on one hand to avoid the stalemate of initiatives in support of greater sustainability, and on the other, the tendency for mere greenwashing by companies who find themselves alone in this scenario. Institutions will play a key role in guaranteeing a systemic rather than individual approach to this dialogue, and in particular trade associations and manufacturing unions, which can play a mediating and facilitating role in the political world, while also acting as a scientifically enlightened guide. The undisputed role of politics in this case should not be overly conditioned by the positions of end consumers who are but one link in the supply "chain", but rather by all parties making up all links of the chain.

Legislation, regulations, economic measures are all very useful instruments in the strive for sustainability, as are the control of raw material prices, incentives for basic and applied research, end consumer information and education policies, and any type of initiative that supports integrated action. In this context, decision-making should be streamlined and cover different levels, from local to international – even more so within the European framework – in order for the transition to be genuinely shared without any significant deviations and progressions at different paces, which more often than not lead to counter-productive results and disagreements.

QUESTION #6:
Flow wrap packaging as "ethical" packaging

The Ethical Packaging Charter introduces 10 values describing the packaging that "designers, producers, converters, industry experts, consumers, users" intend to "imagine, produce, demand, use". How does flow wrap packaging respond to these values? It demonstrates the result of the efforts, experimentation, and research activities of a system and supply chain, represented first and foremost by the producers of film and packaging machines: the materials, seals, barriers play a critical role in the preservation of a product and allow an (almost) new perspective of the complex system of technical-productive, mechanical, chemical, and even aesthetic properties of the container (and not just its contents).

Flow wrap packaging is already ethical. With just a few grams of material, it allows the preservation, transport, and presentation of up to 60 times its weight, guaranteeing quality and the satisfaction of various needs throughout its entire life cycle (for both its use and management, for example). It is safe and accessible; it is democratic; it is reliable, on a physical level because its original properties remain intact throughout its entire life cycle, and on an expressive level, insofar as it responds and easily adapts to rapidly changing languages and values (suffice it to think of coatings, for example, which made it possible to work with monomaterials rather than multi-materials, while still guaranteeing the high performance of the packaging, for greater environmental sustainability). And it can become a tool in itself for an increasingly structured circular economy, to educate about proper disposal, to recycle packaging, and reduce processing waste.

QUESTION #7: Can smart packaging help products withstand extreme conditions?

Flow wrap packaging is the bearer of formal, meaningful, technological, or consumer innovations, through materials, forms, colours, finishes, and all those aspects and details allowing a proper user experience and improved relationship between product and packaging, packaging and user, product and user. Interaction with packaging and how its contents are used will certainly change in the future.

The packaging of the future may be smarter than that currently available, and not only dialogue with the packaged product and its consumer, but also establish relations with the Planet. What we as authors hope, is that future packaging is able to grow and mature, to support the product it contains, going beyond its current role of protection and preservation: if the packaging sector were to follow suit with the research being conducted in other sectors, such as textile design for example, where a number of experts are experimenting the possibility of replacing classic fibres with those derived from living micro-organisms, then packaging too could come "alive".

New material trends are in fact geared towards the potential of a new industrial revolution: biotechnology or even synthetic biology can lead (and are already doing so in part) to the development of packaging that is eaten, that feeds us, the land, plants, or other forms of life, and which can help grow what it contains.

The technologies which on one hand push towards a new circularity, towards biotechnological production systems where organisms become active components of a "tailor-made" production (and consumption) process, in a truly endless cycle, are on the other hand able to improve the properties of flow wrap packaging to such an extent that it could even – who knows – save ancient seeds from extinction or perhaps protect and transport the scent of an extinct flower.

Photo credits

Time pills:
Campbell Wrapper Corporation Archives; Matteo Damiano Dalla Vecchia Family Archives; Barilla Group Archives; Coop Group Archives; Syntegon Group Archives; Fondazione Fiera Milano Hystoric Archives; Studio Giulio Iacchetti Archives and relative photos by Fabrizia Parisi; Taghleef Industries Archives; Bycroft boy via Flickr | Nabisco, From American Cookery 1915 | Public Domain Mark 1.0; Bycroft boy via Flickr | Nabisco, Here, it's the Uneeda Boy providing cookies to the mom and her two kids, published in the August, 1930 issue of the PEOPLE'S POPULAR MONTHLY, source: Charles Perrien Restoration by Charles Perrien | Public Domain Mark 1.0 | CC BY 2.0; F. Delventhal via Flickr | Magnum, Rest Area stop in Santa Sofia on the way to Evora | CC BY 2.0; Hagley Museum and Library (Courtesy of); Digital Collections Library of Congress Photo Archives, New York Public Library | Irma and Paul Milstein Division of United States History, Local History and Genealogy, The New York Public Library (1887-1964). Queens – 209-16 Jamaica Avenue – 209th Street; Digital Collections Library of Congress Photo Archives, New York Public Library | In the vintage kitchen blog; A. Kniesel via Wikimedia Commons | Mon Chéri pralinés von Ferrero | CC BY-SA 3.0; Kration.info | An early 1944 Breakfast unit with the malaria warning on one of the side panels | (Courtesy of); Kration.info | Although the outer box is missing here, it is of the typical composition for the Type IIIb/IVa with the York Milk Caramels | (Courtesy of); Made in Chicago Museum; National library of New Zeland | Imperial Chemical Industries (ICI), ICI House, Wellington, boiler room. Winder, Duncan, 1919-1970: Architectural photographs. Ref: DW-1277-F. Alexander Turnbull Library, Wellington, New Zealand. /records/23203266 | Imperial Chemical Industries (ICI), ICI laboratory, Gracefield, Lower Hutt. Winder, Duncan, 1919-1970: Architectural photographs. Ref: DW-1281-F. Alexander Turnbull Library, Wellington, New Zealand. /records/23185348 | Ration dump at Tambama, Vella Lavella, Solomon Islands, during World War II. New Zealand. Department of Internal Affairs. War History Branch: Photographs relating to World War 1914-1918, World War 1939-1945, occupation of Japan, Korean War, and Malayan Emergency. Ref: 1/4-020427-F. Alexander Turnbull Library, Wellington, New Zealand. /records/22705616; New York City, 1890, Vintage, Mulberry Street, New York, Manhattan, United States of America, culture, city, immigration, America via Pikist; ICP online portal; Pixabay online portal; A. Shvets via Pexels; TamperTechTeam via Wikimedia Commons | Tamper evident seal | CC BY-SA 3.0

Interesting eco-packaging facts:
Lactips press kit; MATto – materioteca del Politecnico di Torino, DAD – Department of Architecture and Design, courtesy of Sara Tiralongo; Sylvicta by Arjowiggins press kit; Taghleef Industries Archives; Ulma Packaging Group Archives

Company stories:
Barilla Group Archives; Campbell Wrapper Corporation Archives; Cavanna Packaging Group Archives; Coop Group Archives; Ima Ilapak Group Archives; Montello Group Archives; Syntegon Group Archives; Taghleef Industries Archives

Other sections of the White Paper:
Cavanna Packaging Group Archives; ICP portal; MATto – materioteca del Politecnico di Torino, DAD – Department of Architecture and Design, courtesy of Sara Tiralongo and Alessandra Campagna; Montello Group Archives; Oregon State University, _MGL0206 via Flickr | CC BY-SA 2.0; Sugarillos – A Teaspoon of Sugar by Mousegraphics'

Acknowledgements

Special thanks go to Riccardo Cavanna, Amedeo Caccia Dominioni, Miriana Brigo, Elisa Laria, Roberto Cerutti, and Bill Kehrli, for having made this project possible.

For their strategic advice, we thank Claudia De Giorgi and Pier Paolo Peruccio, and for their technical support and valuable input, we thank Paola Ferrero, Monica Margara, Marco D'Addario, and Rita D'Attorre.

We thank Jim Pittas, Tom Egan, and Alberto Palaveri for their precious help in presenting this publication.

For the scientific insights into the issues addressed by the publication, we thank our colleagues Annalisa Apicella, Laura Badalucco, Marco Bozzola, Flaviano Celaschi, Clara Giardina, Loredana Incarnato, Sara Limbo, and Paola Scarfato.

For their cherished contribution, we thank Taghleef Industries, Campbell Wrapper Corporation, Cavanna Packaging Group, IMA Ilapak Group, Syntegon Group, Barilla Group, Coop Group, and Montello Group.

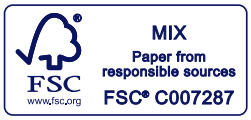
For having joined the study, making it possible to access the company facilities and archives, we also thank: Michele Allamprese, Francesca Amalfitano, Monica Battistella, Alessandra Bruno, Diana Bruno, Rodolfo Cattoi, Filippo Cocchi, Paola Dalla Casa, Rosita Fattore, Paolo Fioravanti, Simona Fontana, Silvana Gheno, Renè Koehler, Silvia Mastagni, Mario Molinaro, Silvia Nicolais, Graham Nice, Bruno Oberle, Roberto Pagliari, Klaus Peter, Giorgio Quagliolo, Andrea Querzoli, Markus Rustler, Francesca Sancinelli, Stephan Schuele, Alberto Vacchi, Luciano Villani.

For their oral testimonies, we thank Giovanni Ballerini, Paolo Barilla, Jenny Baxter, Luigino Birro, Elio Brolli, Antonio Copercini, Matteo Damiano Dalla Vecchia, Maurizio De Costanzo, Renzo Francioni, Luigi Ganazzoli, Fabrizio Gerosa, Franco Goglio, Ralf Hansel, Davide Jarach, Michael Jarmuskiewicz, Valentina Masotti, Giorgio Marazzi, Ludovico Rangoni Machiavelli, Luca Ruini, Julia Schwoerer, Fabio Terziotti, Italo Vailati.

Moreover, our heartfelt thanks go to all those who have helped make this project a success, who contributed to our research with their valuable responses.

Lastly, we thank the generosity of the artist, poet, and photographer, Luca Artioli, who granted us the use of one of his photos for the cover image of the White Paper, which perfectly represents the world of flow wrap packaging and the research flow of the project.

A special mention also goes to Luca Maria De Nardo for having created the opportunity to develop this research project, and for the added value of his suggestions and inspirations.



This book is printed on FSC forest friendly paper.
The FSC logo identifies products which contain paper from forests
managed according to strict environmental,
economic, social standards defined by the Forest Stewardship Council.

This publication investigates the role of a packaging type that perfectly represents the flexible packaging sector: flow wrap packaging. The White Paper summarises the key stages of its evolution, from the production sector to design aspects, and its role in society and consumption. The activities were conducted by a group of researchers from the Department of Architecture and Design of the Politecnico di Torino, in constant dialogue with the various components of the supply chain involved with the packaging, at both a national and international level. The findings were then collated and made available to a broader public through the drafting of this document, a scientific publication structured in such a way as to generate culture on the theme of flow wrap packaging. The current and future challenges faced by this packaging, linked to the innovations of production materials and technologies, and new ways of containing, selling, consuming, and communicating, are increasingly geared towards sustainable solutions.

#circulareconomy
#flexiblepackaging
#flowwrap
#foodpackaging
#innovativepackaging
#monomaterial
#packagingdesign
#packagingsolution
#productdesign
#recyclingplastic

Out of stock

ISBN 978-88-6627-358-5

9 788866 273585