

Information service offered to plastics & rubber technological companies by Maris SpA



JOURNAL

# MARIS

N.06

NEWS FROM THE COMPOUNDING WORLD

## CIRCULAR ECONOMY

### STRATEGIES AND OVERVIEWS: TOWARDS A PLASTICS CIRCULAR ECONOMY

The invention of 'plastics' dates back to over a century ago and it is undoubtedly one of the materials that most characterize our lifestyle and production system.

**E**asy processing, versatility, mechanical properties, insulating effect and many other qualities justify its advantageous use in several fields (packaging, construction, transport, health, cosmetics and so on).

Nevertheless, plastic has recently been in the spotlight of a media campaign whose aim is to highlight those end-of-life plastic materials issues that may arise when plastic is not properly disposed of and recycled.

The goal we should therefore all set for ourselves is to combine the environmental protection

together with the various needs of the productive sectors.

The strategy is hence to create and strengthen 'a new plastics economy' with the aim of extending – as much as possible – plastic life cycle through its re-use and recycling, as well as promoting the recourse to more sustainable materials.

Future investments should be aimed at the renewal of materials and production techniques that would be beneficial for the economic system, the environment and the quality of life.

There are of course several targets that we should set for ourselves, including:

- to produce reusable or recyclable plastic in a sustainable way;
- to grow the market for recycled or innovative plastic products;
- to reduce CO<sub>2</sub> emissions;
- not to leave plastic in the environment

The actors of this new Economy are public institutions, national and international associations, companies operating in the plastics sector and – last but not least – the good behavior of single citizens.

More in detail, the increase in the plastic recycling opportunities goes through a new way of designing materials and final products. It is therefore necessary to establish new production methods and to support conscious and virtuous consumption choices so that to create an effective circularity of the system.

Companies in the sector are already trying to respond to these requests by implementing energy-saving interventions for their production processes, by working on products eco-design towards a greater recyclability or – in addition – by establishing a collaborative relationship between the producer and the user along the whole production chain.

**Let's use plastic responsibly!**

**MARIS, PARTNER OF AreYouR PROJECT**



*AreYouR is a project that aims at raising the awareness of the European citizens about the environment and about the benefits of recycling plastic materials.*

'Plastic' has often been subject to negative publications due mostly to the improper disposal of its related waste. It is so rooted in everyday life and it is so simple to use that it becomes just as easy to get rid of. By adequately disposing of it, we can ensure it to be properly recycled and therefore give a new life to common use products.

Over the years, plastic materials – thanks to their multiple properties – have gained so significant importance in many sectors, that their replacement with other materials is considered unthinkable. Our goal shall therefore be to strive for an aware use of plastics by manufacturing products with materials that – at the end of their life cycle – can be easily inserted into the recovery chain.

Follow new developments on:

[www.areyour.org](http://www.areyour.org)  
or on Facebook

@AreYouR.recyclingcommunity



### THE WORLD'S NO.1

**Trade Fair for Plastics and Rubber will be held in Düsseldorf from 16th to 23rd October, 2019.**

With its over 3.200 exhibitors on an area of more than 175.000 sqm, K 2019 will be again the biggest event for the industry and the starting point for economic decisions about products and processes.

The event is expected to attract around 200,000 visitors from over 100 different countries, because when you plan to do business in the innovative plastics and/or rubber industry, the foremost platform worldwide is K. For this exhibition, Maris has been assigned a booth of 170 sqm in the Hall 16, with stand number 16B59, where two highly technological machines, part of our production range, are shown. They are an extruder model TM41HF/47D and an extruder model TM70HF/44D.

**These models represent the latest developments and innovations concerning our extruders, notably as for the following application sectors:**

- production of high-dispersion and high-capacity masterbatches
- production of rubber compounds and

rubber recycling (devulcanization process)

- recycling of high add-value materials (circular economy)
- production of adhesives (hot-melt, solvent-based, total solid)
- production of biopolymer and compounds

**Our commercial and technical staff is eager to welcome you at our booth:** do not miss the opportunity to meet us in that occasion and to discuss new projects together!



# RECYCLING

At a time when the recovery of plastic materials plays a key role in the Circular Economy, MARIS has studied and designed specific extruders to achieve this goal.



The intrinsic characteristics of co-rotating twin-screw extruders can ensure not only excellent homogeneity, degassing and filtration levels of the processed material, but also offer the possibility of adding fillers and/or additives.

Thanks to the optimization of this process, the materials produced with MARIS extruders can improve their mechanical and aesthetic performances turning waste and scrapes into compounds required by the market.

Processed plastic materials may be both highly selected and low in contaminants (post-industrial) as well as partially selected with a high content in contaminants (post-consumption).

The table shows some examples of recyclable materials:

RECYCLABLE MATERIALS	PARTICULAR PROCESSES
Polyolefin PVC PET PA Foamed materials Rubber Vulcanized rubber	Odor reduction De-inking      <b>Devulcanization</b>

FILM PE/PA (80% / 20%)



INKED LABELS PP BASED



PE/PP FILM + CaCO<sub>3</sub> (65%)

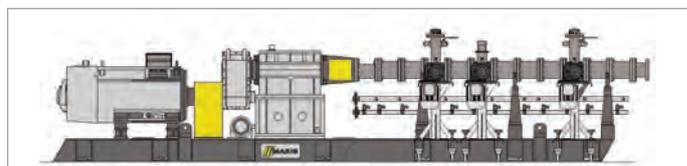


ADHESIVE PP BASED



According to the type of material and the specific needs, the recycled product can be re-used – in variable percentages – in the same process or used for new applications.

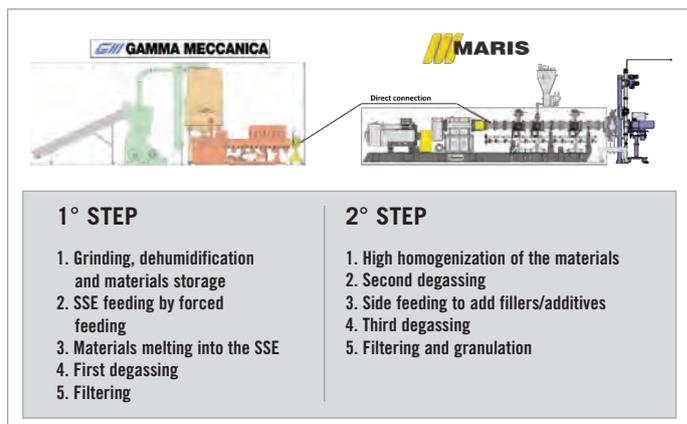
The image below shows an extruder typically used for recycling processes:



## RECYCLING WITH EVOREC

To the need of recycling highly contaminated materials with high moisture percentages, MARIS answers with Evorec.

The combination of two great experiences has made it possible – within a single plant – to recycle highly critical materials by using Gamma Meccanica single-screw extruder and Maris co-rotating twin-screw extruder.



In order to test the recycled materials quality and their production efficiency, it is possible to carry out tests at MARIS Technology Center.

## How to achieve the impossible

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# HIGHLY FILLED COMPOUNDS

Highly filled compounds are particular materials with a high percentage of mineral filler dispersed into a polymeric matrix that allow to considerably reduce production costs if compared to the standard masterbatches.



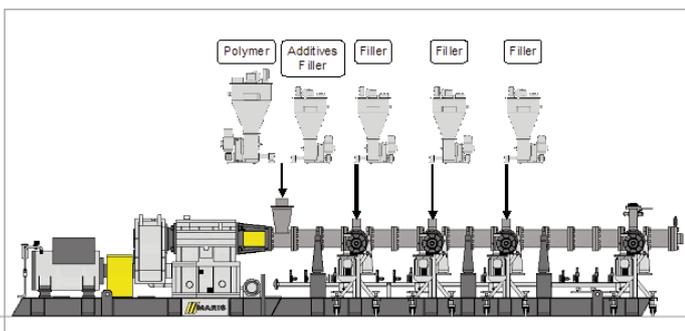
POLYMERIC BASE	MINERAL FILLER
LLDPE	Calcium carbonate
HDPE	Talc
PP	Magnesium hydroxide
EVA	Titanium dioxide
PS	Antimony oxide
PLA	Calcium oxide
	Kaolin

In order to increase extruders performances over the years, MARIS has made numerous technical process improvements maximizing - therefore - both the filler percentage and the output capacity.

The most important developments can be summarized in:

- several Do/Di ratios which imply different free volumes;
- a wide range of extruders with different specific torques;
- the possibility to add the filler in four different feeding points (one in the main feeding and three in the side feeding);
- special equipment - including the deaeration system - to facilitate the introduction of fillers that normally tend to incorporate air;
- optimization of the screw profile and screw elements specific for this particular process.

The synergy of these technical solutions has allowed us to reach filler percentages up to 80-85%, preserving the output capacity and keeping excellent dispersion standards. The achievement of these excellent results has also been possible thanks to the formulations and materials optimization from the Customers themselves.



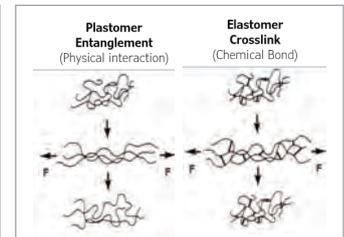
Process layout of highly filled compounds

To verify the quality of glass-fiber-reinforced plastics and their production efficiency, it is possible to carry out tests at MARIS Technology Center.

# RUBBER DEVULCANIZATION

The devulcanization is a selective breaking process of an elastomer S-S and C-S bonds, which produces only a limited degradation of the polymeric structure (C-C bond).

Nowadays, different methods to obtain a devulcanized product are known and may be physical (ultrasound, microwaves, and mechanical stress), chemical (the use of devulcanization additives) and synergistic (thermo-mechanical, thermo-chemical).



The thermo-mechanical devulcanization is possible as S-S, C-S and C-C bonds have different energy, which is respectively of 370, 310 and 270 kJ / mol. Thanks to the appropriate combination of thermal and mechanical energy, it is possible to selectively break S-S and C-S bonds.

MARIS, active in the field for more than 10 years now, has developed a thermo-mechanical synergic process - without the use of chemical additives - that has been used on a large industrial scale and which involves the rubber transition from an elastomeric cross-linked system (vulcanized rubber) to a plastic non-cross-linked system (devulcanized rubber).

MARIS devulcanization process allows to work the following types of rubbers:

- ACM - Polyacrylic Rubber
- EPDM - Ethylene Propylene Diene Monomer
- FKM - Fluorelastomers
- IR - Isoprenic Rubber
- IIR - Butyl Rubber
- NR - Natural Rubber
- SBR - Styrene Butadiene Rubber

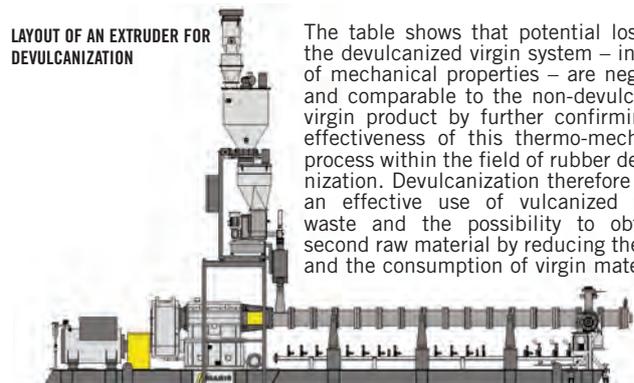
Chemical and rheological analysis carried out on the devulcanized material have shown that - through this process - a devulcanization yield of 70-80% can be obtained.

Furthermore, it is possible to re-use from 15 to 50% of the devulcanized material for the same application of origin and, according to the material final use, it is possible to increase the percentage of devulcanized material of the final compound (over 50%).

The table below compares the mechanical properties of an IR-based vulcanized compound (100% virgin) and a vulcanized compound containing 40% of devulcanized IR, both used for the same application and vulcanized in the same way.

	IR Virgin	IR Devulcanized (40% Virgin (60%))
Modulus at 100% (M Pa)	0.95	0.90
Modulus at 300% (M Pa)	1.78	1.75
Tensile strength (M Pa)	22.91	19.94
Elongation at break (%)	891	835
IRHD Hardness	67.1	62.2
Elastic Yield	48.4	42.8
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LAYOUT OF AN EXTRUDER FOR DEVULCANIZATION



The table shows that potential losses of the devulcanized virgin system - in terms of mechanical properties - are negligible and comparable to the non-devulcanized virgin product by further confirming the effectiveness of this thermo-mechanical process within the field of rubber devulcanization. Devulcanization therefore allows an effective use of vulcanized rubber waste and the possibility to obtain a second raw material by reducing the costs and the consumption of virgin material.

# CONTINUOUS ADHESIVE PRODUCTION

Since 1962 – its foundation year – MARIS, manufacturer of co-rotating twin-screw extruders, has been leader in the research of new state-of-the-art applications for its products. With the aim of providing the Customer with the widest range of choices, every mechanical component of the extruder is entirely in-house manufactured. As a matter of fact, MARIS is one of the few companies in the world to be able to customize its co-rotating twin-screw extruders according to the Customer's specific needs and this is true also when it comes to the continuous adhesive production.

MARIS boasts many years of experience in this sector that has been translating into a constant co-rotating twin-screw extruder technology optimization for the continuous production of the following types of adhesives:

- HOT MELT ADHESIVE
- SOLVENT BASED ADHESIVE
- TOTAL SOLID ADHESIVE

Their production is traditionally carried out in a discontinuous way. This process however presents some criticalities, which can be summarized in the following points:

- difficult reproducibility, as each production lot may have different characteristics;
- difficult cleaning;
- high number of phases in succession;
- operator involvement in almost all stages of the process. This may result in a prolonged exposure to chemicals used and therefore pose a risk to his health and safety.
- low automation.

These issues can therefore be overcome thanks to the continuous process performed by the co-rotating twin-screw extruder, which has the following features:

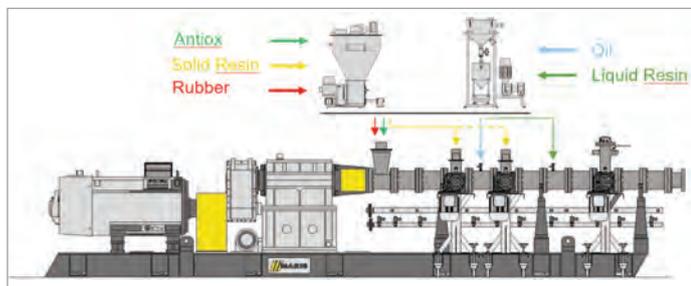
- easy reproducibility;
- easy cleaning. As a matter of fact, the screw profile of a co-rotating twin-screw extruder is self-cleaning and it therefore allows a quick shift from a formulation to another;
- closed system and safer process for the operator because exposures to the chemicals used are very limited;
- fully automatic process, where the formulation components are precisely fed by means of gravimetric feeders;
- continuous monitoring of process parameters.



## PRODUCTION PROCESSES ARE LISTED AND DETAILED BELOW.

### CONTINUOUS HOT MELT ADHESIVE

PICTURE 1 SHOWS A TYPICAL LAYOUT FOR THE CONTINUOUS PRODUCTION OF HOT MELT ADHESIVE.



### CONTINUOUS SOLVENT BASED ADHESIVE

The solvent-based adhesive discontinuous production – the traditional one – presents the following critical aspects:

- conspicuous percentage of solvent (between 65% and 70%);
- large amount of solvent-based

- adhesive within the production area;
- dilated solvent evaporation time;
- remarkable level of solvent evaporation energy;
- significant quantity of solvent dispersed in the production environment;
- low automatization.

Thanks to the considerable experience acquired in the field, MARIS offers continuous production systems in order to overcome these criticalities.

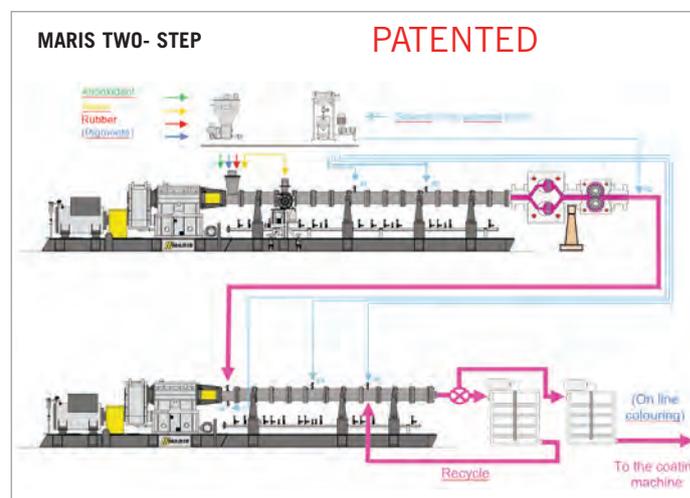
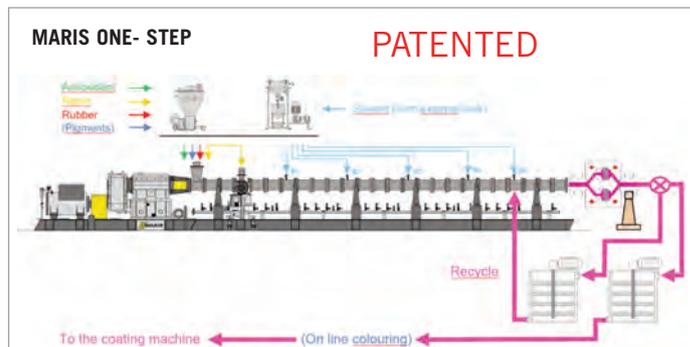
Those production systems proposed may be of two types:

ONE-STEP (Picture 2)

AND TWO-STEPS (Picture 3).

Both share the following features:

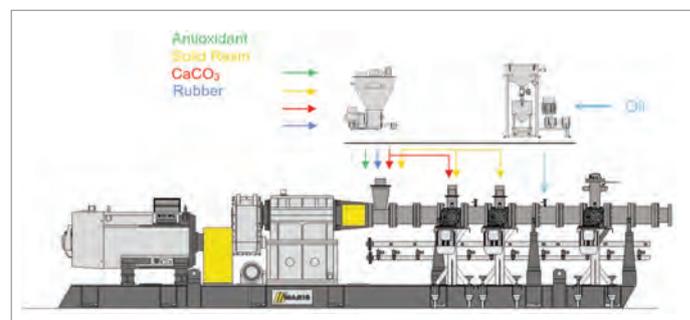
- the percentage of solvent can be reduced up to 40%;
- low amount of solvent-based adhesive within the production area;
- reduced solvent evaporation time;
- reduced solvent evaporation energy;
- closed system and drastic reduction of solvent dispersed within the working environment.



Although more complicated due to the high number of components, the two-step process guarantees a higher flexibility as well as a greater output capacity with the same formulation.

### TOTAL SOLID ADHESIVE

PICTURE 4 SHOWS A TYPICAL LAYOUT FOR THE CONTINUOUS PRODUCTION OF TOTAL SOLID ADHESIVE.



In conclusion, the continuous production system of these products represents a valid and concrete step forward if compared to the traditional production ones both in terms of working environment safety and in long-term energy and economic savings.



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