

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



N.02

JOURNAL

# MARIS

NEWS FROM THE COMPOUNDING WORLD

They didn't know it was impossible, so they did it..

(Mark Twain)

**OVERCOMING THE LIMITS WE CAN OFFER YOU THE MOST INNOVATIVE SOLUTIONS ..enjoy the reading**

Dear readers, "Maris Journal" has been edited with the aim to let you know our structure and our team, with our face, our works and projects. Confident about your liking, we will continue to keep you updated on the innovations of our activity... we are pleased to introduce the edition n° 2. THANKS ... to be continued.



**TOGETHER FOR A GREENER WORLD!**

## RUBBER RECYCLING BY USING A CO-ROTATING TWIN-SCREW EXTRUDER

**D**uring difficult periods, people always tried to save resources. We can mention recent examples as during WW 2, when people were asked to hand over the metal in their possession for the manufacturing of arming, or during the energy crisis of the 70s. During these periods, recycling turned into business, both for the lack/cost of raw materials and for the expansion of an envi-

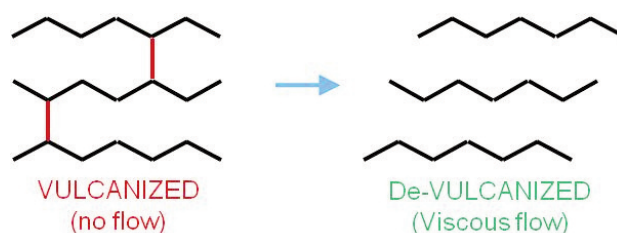
ronmentally friendly culture. The MSW (Municipal Solid Waste) recycling, such as glass, paper, cans and plastic, became an economically profitable process. Furthermore, in order to reduce production costs, non-conforming material (from the formulation or physical point of view) can be re-used. In the rubber-plastics sector, due to the raw material costs and the poor biodegradability of post-consumer materials, the necessity to recycle is getting vital. For plastic materials, this is quite simple, since they can be heated and easily remould keeping their final properties, as the sole interactions between the macromolecules are simply of physical nature.

### What about the rubber?

Unfortunately, for vulcanized elastomers, which we normally call "rubber", it is not so easy. In fact, the vulcanization reaction, discovered by Mr. Goodyear in the second half of XIX Century, produces indissoluble chemical

bonds between the polymeric chains, creating a real grid by means of the elastomer reaction and the curing agents. The vulcanization reaction is an irreversible chemical reaction, i.e., once it happens it will be no more possible to return to the unsaturated not-vulcanized elastomer and the vulcanizing additives. Therefore, the end-life materials such as technical articles, tires (just to give an idea about the volumes, in 2014 in Italy 28 millions of car tires have been recycled), and scrapes have no other destination than being thrown in the landfill and just a little quantity can be burned or grinded. The technologists have always paid attention to this environmental problem, trying to find chemical or physical systems to obtain a plastic material from vulcanized elastomers, calling these systems "devulcanization". The twin-screw extruder versatility allows MARIS to approach applicative sectors quite different from the traditional ones, so that during the last years our R&D department could focus on a reliable and environmental friendly process, which allow the continuous recycling of vulcanized rubber.

**DEVULCANIZATION TARGET: SELECTIVE BREAK OF CROSSLINK BONDS**  
(Typically C-S and S-S bonds)



## LET'S DEEPEN THE MATTER ASKING SOME QUESTIONS TO DR. GALLO OF MARIS TECHNOLOGICAL CENTER:



### Why did the devulcanization process rise?

A. - Our devulcanization process of thermo-mechanical type, originate both from an environmental and an economical necessity. Environmental, because the working scraps and the post-consumer materials are uneasily reused into the same production process from which they originate and they are normally worked through unsustainable processes; economic, because it allows to reduce production costs, obtaining a secondary raw material from selected scraps, which is compatible with the starting formulation.

Certainly in the future (in Europe such tendency is already widespread) the limited use of the landfill for this type of waste will be more and more required. During the last years, the process has been improved, reducing the energy consumption and the mechanical worn, by acting on the extruder configuration in order to process different types of elastomers, optimizing the process parameters for the different materials.

### Can you describe specifically its functioning?

A. - This process, merely thermo-mechanical, does not require any chemical or chemical-physical additive (such as the supercritical CO<sub>2</sub>), thanks to the features of the co-rotating twin-screw extruder, i.e. flexibility and high mixing

efficacy, achieved through the screw configuration. The process, heating the material to "uncommon" temperatures for the rubber, applies a selective shear-stress on the product, breaking mainly the crosslink bonds without excessive degradation.

### You used the word "degradation", to what extent does it happen?

A. - Of course, it does not exist a process, which breaks the crosslinks without degradation of the polymeric chain. It is intrinsic to the nature of the vulcanized elastomer that there is a partial degradation but thanks to a study carried out by CERISIE on our samples, it has been verified that the degradation is very poor. In fact, the material produced with our extruder can be re-used in a percentage between 15 and 50, depending on the original properties of the blend to be devulcanized and on the final product specifications.

### What about the Sulphur ?

A. - Imagine a party, where people meet, discuss and spend time cheerfully with other congenial people. It is easy to think that they reach the party with a group of friends, then they meet new people and create new groups. Inside the extruder, something similar happens; all chemical

bonds are excited and can break (more easily the crosslink), creating some different bonds. The Sulphur, together with the chain scraps divided due to the thermo-mechanical process, re-combines in other molecules, as ascertained by environmental analysis carried out around the extruder.

### You spoke about environmental analysis. Are there any risks?

A. - A certain number of molecules containing Sulphur atoms have been found in the atmospheric emissions, the condensate and the water of the vacuum pump closed circuit. It is important to underline that normally you do not get in contact with these substances, as they are removed by the vapors and gases suction device above the extruder.

der, while the fluids are in zones accessible only when the equipment is off. The atmospheric emissions have to be treated according to the rules in force and the fluids have to be properly disposed. Such emissions can vary depending on the elastomer type. As a service to our Customer, we have therefore developed an analytic method, which enables us to know the analytics by means of trial cycles carried out in our Technological Center using the Customer's specific material. In this way, we can evaluate the emissions during the production cycles.

### In terms of costs, which are the figures?

A. - From an energetic point of view, the average consumption is 0.4-0.8 kWh/kg. As far as costs are concerned, taking into consideration the use of an equipment having an output of 400 kg/h for 24h, the indicative figures are 300 - 400 €/ton. Such cost includes the entire process, from the milling to the cooling at the exit of the extruder.

### Is it logical to invest in this process?

A. - Until recently, when the vulcanized rubber recycling appeared to be impossible, our answer would have been "NO". Now, after a number of lines sold, we are convinced that this process is the solution to an industrial problem of high environmental impact. For this reason, during the congresses, we invite the companies to test their own materials and to ascertain personally the obtained results.





## EXTRUSION LINES: MACHINERY OR PARTLY COMPLETED MACHINERY?

Since the very beginning in 1993 Machinery Directive has been a milestone, both for the free circulation of machinery within the EU and for the safety of the workers. In recent years the Directive has been discussed and its achievements have been consolidated by Directive 2006/42/EC. In order to help machinery users and manufacturers to understand and comply with the requirements of the Machinery Directive, an official EU guide has been prepared and implemented. In order to provide our customers information on the procedures required by the Machinery Directive, Maris has prepared a series of articles, which will be published on this "Maris Journal". This first article deals with the difference between a machine and a partly completed machine. One of the most critical issues to deal with is the difference between a machine and a partly completed machine. This point needs to be understood, as it involves responsibilities of both the machinery users and the manufacturers.



*Machinery Directive defines machinery as:* "an assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort, consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application," or "assemblies of machinery ...or partly completed machinery ...which, in order to achieve the same end, are arranged and controlled so that they function as an integral whole". Partly completed machinery is defined as "an assembly which is almost machinery but which cannot in itself perform a specific application. Partly completed machinery is only intended to be incorporated into or assembled with other machinery or other partly completed machinery or equipment, forming machinery to which this Directive applies". The difference is that the CE marking on a machinery is affixed by the manufacturer, whilst on a partly completed machinery the CE marking shall be affixed by the natural or legal person who incorporates it into or assembles with other machinery or other partly completed machinery. This means that, unless otherwise specified, the machinery user should be identified as manufacturer of the assembled machinery, therefore bearing all the responsibility of the manufacturer as described by Article 5 of Directive 2006/42/EC.

In order to avoid any misunderstanding when the customers receive the machinery, before submitting any quotation, Maris check if what is offered could be considered as a partly completed machinery. This could be the case, for instance, of an extruder to be incorporated in a line for BOPP, where the control board controls all the line, composed by other partly completed machinery. In this case, it is the customer's responsibility to assess the risks of the whole line, checking the documents provided by each supplier and to assess the risks at the interfaces between machines. On the other end, Maris fulfill their duties providing the customer with the Declaration of Incorporation (DoI), listing all the Essential Health and Safety Requirements (EHSRs) of the Machinery Directive applied and fulfilled.


**The next article will deal with the Essential Health and Safety Requirements and the Technical File.**

...to be continued.

➡ THE MACHINERY DIRECTIVE 2006/42/EC CAN BE DOWNLOADED FROM:  
[http://ec.europa.eu/enterprise/sectors/mechanical/documents/legislation/machinery/index\\_en.htm](http://ec.europa.eu/enterprise/sectors/mechanical/documents/legislation/machinery/index_en.htm)


➡ THE GUIDE TO APPLICATION OF DIRECTIVE 2006/42/EC CAN BE DOWNLOADED FROM:  
[http://ec.europa.eu/enterprise/sectors/mechanical/documents/guidance/machinery/index\\_en.htm](http://ec.europa.eu/enterprise/sectors/mechanical/documents/guidance/machinery/index_en.htm)






**MARIS**  
Technological Company

## LINES FOR RUBBER






CONTINUOUS SYSTEMS FOR COMPOUNDING



RUBBER RECYCLING

**Working for a better world!  
Recycling rubber  
by devulcanizing it!**



## CASE: UHMWPE FILM

One of the most recent applications realized by our Company concerns the production of a microporous film having a thickness between 9 and 20  $\mu\text{m}$ , with UHMWPE base. This semi-finished product has its main use in the production of film for batteries. The requirement is to grant a product homogeneous and regular in thickness and, above all, in dimension and micro holes distribution.

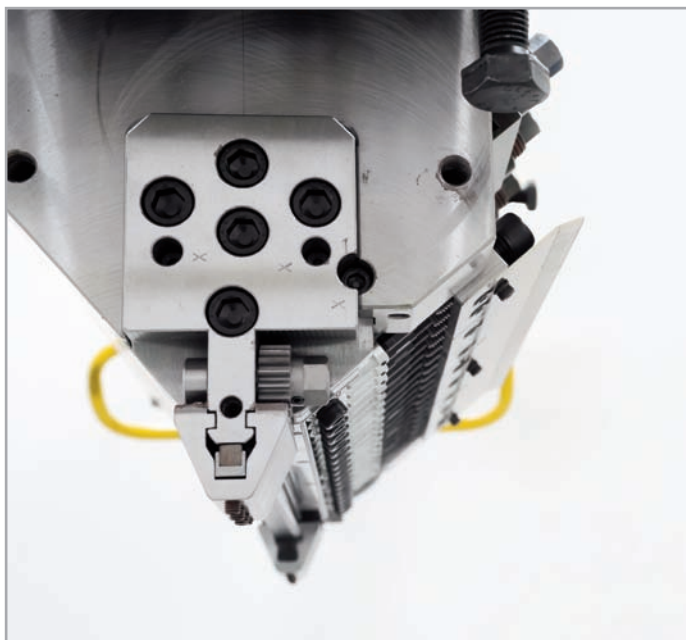
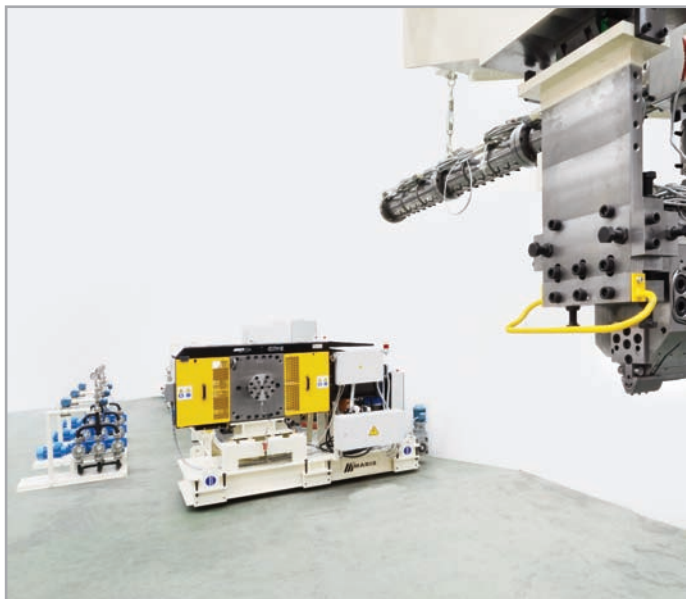
The line, beside the extruder, includes upstream very precise feeding system and downstream gear-

pump and flat die, which feeds the end of the line for product finishing.

The critical issue of this process is the necessity to mix the polymer with a very high quantity of oil (for each part of polymer, there could be up to four parts of oil), which has to be removed during the post-processing phase to obtain the micro holes.

In order to reach this important result, the process zone has been shaped in such a way to foresee the introduction and the distribution of the oil in different points, together with a specific screw profile, the core of the process, realized to obtain the best homogenization of the two ingredients.

Thanks to this application, Maris confirm once more that their ambition is to deal with new challenges and new processes.



## PLAST 2015 MILAN, 5TH TO 9TH MAY 2015

ON SATURDAY MAY 9TH 2015  
CLOSED THE MOST IMPORTANT  
EUROPEAN EXHIBITION OF THIS  
YEAR FOR PLASTICS AND RUB-  
BER SECTORS.

Nearly 1600 exhibitors from 57 different countries took part at PLAST 2015 with an increasing of 5% compared to 2012. The booths were allocated inside six complete halls of FIERA MILANO.

With more than 50.000 visitors during the five show days, 35% of which from abroad, PLAST 2015 can celebrate its positive results.

Our company was present with a booth of 220 sqm in the hall 13 and showed three extruders being part of our production range:

a TM92MV/52D,

a TM59HS/48D,

and a TM20HT/48D.

We had been pleased to welcome our customers in a very nice and comfortable area.

The next edition of PLAST will take place from September 26th to 30th 2017.



▶▶▶ NEXT EXHIBITION:  
PLAST EURASIA ISTANBUL 2015  
December 3rd to 6th, 2015  
Visit us at Hall 4 - Stand 409D

## DKT / IRC 2015 NUREMBERG, JUNE 29TH TO JULY 2ND 2015

More than 270 exhibitors and hundreds of professional attendees: these are the numbers, which confirm DKT and IRC of Nuremberg as worldwide interest events. Maris was there with its own booth.

Thanks to our innovative "rubber recycling process by devulcanization" and to the reliable "rubber compounding continuous system", both realized by the use of our co-rotating twin-screw extruders, a good number of interested visitors has come to our booth.

The variety of possible uses of our extruders has caught the attention both of professionals taking part to the conferences and other exhibitors. We look forward to meet you in the next edition of the fair or to welcome you in our facilities to deepen all the aspects related to the use of our co-rotating twin-screw extruders in rubber field.



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