



There is chemistry between man and nature

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Matrica is a concrete example of a site reconversion by the integration of chemistry and agriculture which has resulted in the first biorefinery integrated into the local area through the strong involvement of farmers, universities, research centres and local communities.

Matrica: the biorefinery integrated into the local area



A technological leadership respectful of sustainability

Matrica is the joint venture between Versalis (ENI), a company specialized in the manufacturing and marketing of petrochemical products, and Novamont, leader in the bioplastics market. The exceptional expertise of these two major Italian concerns have given origin to the establishment of an innovative enterprise which merges the best of both into a single entity dedicated to the production of an unprecedented range of products made from renewable raw materials with low environmental impact.

Matrica's objectives are based on some fundamental criteria that are central to all the activities of the biorefinery:

Integration with local communities and the local area

Matrica plants are located in Porto Torres, in a rural area with a wealth of marginal lands that are suitable for the sustainable production of biomass from low-input multiannual crops. The presence of the new production

facility is helping to bolster the local area's competitiveness and its capacity for innovation, maximizing its potential for growth on various fronts and providing enormous benefits on several fronts ranging from the primary sector (agriculture and the rearing of livestock, to name but a few) to the secondary sector (farming vehicles and equipment, logistics and the manufacturing side of the processing of biobased products) and even the tertiary sector (partnerships with local universities and research bodies).



New markets from green chemistry

Renewability and energy autonomy

The Porto Torres biorefinery is a virtuous model of integration between industrial and agricultural production which systemizes and leverages all the elements of the agricultural sector, starting from the selection of the raw materials to supply its industrial needs. Thistle (*Cynara cardunculus* L. var. *Altilis*) is a crop whose particular features are well suited to Matrica's production needs and to the area in which it is found.

It is a low input crop which grows on arid land that is unsuitable for traditional crops. Both the seeds of the thistle, which produce an oil similar to sunflower oil, and its biomass, from which cellulose and hemicellulose are obtained, are used. Flour that is very high in protein is obtained by extracting the oil and can be used as a replacement for soya, which is currently used to feed dairy cattle. Vegetable scraps from the conversion process are then used to meet the energy needs of the entire industrial process, making it fully self-sufficient.

Territorial regeneration

Matrica is the tangible realization of a new model of development based on the importance of research, on continuous innovation and on the enhancement of local biodiversity. It is a model that can trigger territorial regeneration in economic, environmental and social terms, making the most of existing local resources and skills and even having a positive impact on long-term employment prospects.

Replicability

From its inception, Matrica has had the role of a veritable bioeconomy case study which has characteristics that make it suitable for replication in other areas, by adapting to specific local features. Likewise, it can also be adopted for the recovery or revamping of deindustrialized sites, but above all to offer new opportunities for development in Italy and overseas.

Matrica: the plants



The project comprises the setting up of various plants for the production of biomonomers, biolubricants and bioadditives for rubber, all from a renewable source.

Three plants are currently in operation: the first is the plant for the conversion of vegetable oils into monomers and intermediates, providing for the production of well-known intermediates such as azelaic acid and pelargonic acid, as well as new proprietary products, through a safe process with low environmental impact. The second plant, downstream of the first one, produces extender oils developed for the tyre market, and plasticizers for specialty elastomers (like NBR and CR) and PVC, while the third plant can convert monomers and intermediates into high value added products, such as bases for biolubricants and products for pharmaceutical, homecare and cosmetic formulations.

Innovation and integration with the local area



Matrica: the research centre

Laboratories and pilot plants

Back in 2012, Matrica had already established a research centre, which includes an analytical laboratory and 7 pilot plants, covering a total area of more than 3,500 square meters.

The pilot plants are a crucial part of the research centre, enabling it to continue the development of the new technologies being implemented and the development of increasingly cutting-edge products. The area set aside for the pilot plants includes various sections which simulate, on a small-scale, the main chemical and engineering operations,

enabling information and technologies to move rapidly from the small-scale basic research to full industrialization.

The centre operates in synergy with the Novamont and Versalis research centres and in partnership with first-rate national and international institutes and with the regional research system. Special attention is also given to setting up training pathways and professional courses for young researchers, by organizing internships and placements in collaboration with local universities and institutes.



Support for production



Development of new methodologies

Matrilox bioproducts



Renewability and high performance

The launch of the Matrica plants has also given rise to the new trademark Matrilox, which identifies the innovative family of bioproducts for many different market segments: bioplastics, biolubricants, personal care products, plant protection products, additives for detergents and for the rubber and plastics industry. Matrilox products, which are biodegradable and non-toxic, provide a sustainable solution which combines renewability and high performance.

MATRILOX IS THE TRADEMARK THAT GUARANTEES:

Vegetable origin

Matrilox bioproducts come from the use of feedstock from renewable sources which are compatible with the local area and cultivated on marginal lands while maintaining local biodiversity.

Integrated European supply-chain

Matrica follows an innovative development model based on the implementation of an integrated agro-industrial supply chain established into the local area, with low environmental impact. The Porto Torres biorefinery is the only one of its kind in Italy and in Europe, a flagship which puts into practice a true systemic, circular model, offering new, high value added products from materials of European and vegetable origin.

Sustainable production processes

The Matrica plants use a world-first proprietary technology developed by Novamont research, which differs radically from existing technologies: it does not use ozone in the oxidative cleavage reaction of vegetable oil and enables high production capacities through a safe process with low environmental impact.



MATRILOX INTERMEDIATES

Azelaic acid

Very pure azelaic acid, a dicarboxylic acid which presents as a white crystalline solid, is used in polymerization processes, in the production of lubricants and in pharma/cosmetic products. It is also a product of great interest from the chemical viewpoint since it is one of the basic constituents of bioplastics.

Pelargonic acid

Pelargonic acid, on the other hand, is a monocarboxylic acid, which is used as an intermediate in the synthesis of emollients for the cosmetics sector and in the production of biolubricants, on account of its high purity deriving from its purification process. It is also an important raw material in the production of bleaching agents and food aromas. Pelargonic acid is also a natural, full-spectrum herbicide that is used in the formulation of

plant protection products.

Glycerine

Matrica's glycerine is an odourless, colourless liquid with a high level of purity. Glycerine is an extremely versatile polyol which, in addition to its well-known applications as an emollient, wetting agent and buffing agent in cosmetic formulations, is also widely used in the pharmaceutical industry, in the preparation of anti-freeze liquids and as a raw material for the synthesis of esters and epichlorohydrin.

C5-C9 acid blend

This is a blend of carboxylic acids with different chain lengths. It is a transparent liquid.

This blend can be used in the synthesis of esters to obtain bases for the formulation of high-performance lubricants. Synthetic esters produced in this way not only offer excellent properties of lubricity, thermal stability and biodegradability (as is typical of this category of products) but can also be used to make lubricants with very low flow temperatures (Pour Point),

an indispensable feature in aeronautical applications.

Fatty acids blend

This is a blend of saturated fatty acids based primarily on palmitic and stearic acids. The blend of acids obtained by the Matrica process is a wax-like material that is solid at room temperature. There are myriad applications for these products: from the manufacture of detergents, candles, lubricants, cosmetics and stabilisers for PVC to their use as an accelerant in the vulcanisation of rubber.



MATRILOX LUBRICANTS

Matrica offers a wide range of bases for biolubricants constituted of esters for use in the formulation of lubricants for the agricultural, automotive and aeronautical sectors, as well as for the production of hydraulic oils and special fluids for industry.



Their renewable origin and biodegradability make them ideal for use in systems subject to microspillage in delicate natural environments and the plant's exceptional synthesis flexibility also allows for the creation of lubricant bases specifically designed to meet the most stringent application requirements.



MATRILOX COSMETICS

High-purity azelaic acid is used in pharma/cosmetic applications such as the preparation of creams for the treatment of acne and rosacea, creams for skin depigmentation and trichological lotions.

High-purity glycerine is commonly used in cosmetics: it is found in a multitude of products including soaps, essential oils and creams on account of its humectant, moisturising and

conditioning properties.

Alongside the aforementioned products, Matrica also offers the cosmetics industry several innovative biodegradable esters from renewable sources for the preparation of body creams and oils.



MATRILOX PLASTICIZERS

Matrica offers a range of plasticizers for PVC, as well as an innovative type of bio-extender oil for elastomers. The main application field for Matrica's range of plasticizers is the flexible PVC sector, along with other types of elastomers, like NBR, and CR.

Matrilox bioplasticizers offer a high-performance, non-toxic, eco-sustainable alternative to traditional plasticizers (phthalates). These plasticizers, which have high molecular weight and

low release levels, are able to achieve excellent plasticization and exceptional thermal stability.

Other Matrilox bio-extender oils have been specifically designed for the tyre industry and are destined to replace - partially or fully - extender oils of fossil origin. They can be used for the production of oil-extended rubbers like SBR and BR, and, when properly formulated, as free oils in the production of blends. The peculiar low glass transition temperature of Matrilox bio-extender oils provide an additional tool to tyre industry to develop compounds for low temperature applications (such as winter tyres), and for low rolling resistance, thus helping fuel saving. So, the benefits in terms of sustainability are not limited to the manufacture of tyres, but also to their use.

