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ING. LUIGI LISCIANDRA, SBS STEEL BELT SYSTEMS S.R.L., ITALY, DETAILS THE COMPANY'S DEVELOPMENT OF SULFUR-BASED BIO-FERTILIZERS.

In cooperation with Università Mediterranea of Reggio Calabria, Italy, SBS Steel Belt Systems S.r.l. (SBS) has developed a new process to produce a wide range of fertilizers using sulfur recovered from refineries, agricultural bio-remainders and city bio-waste.

Contemporary research has increasingly focused on the use of agronomic techniques in order to improve productivity, in terms of both quantity and quality of products, as well as the sustainability of farming, by promoting the conservation of natural resources, protecting the soil resource and reducing the environmental impact. Over the next 40 years, agricultural production will face major challenges, such as an increasing population, climate change and land degradation.[1] Climate change is expected to cause substantial reductions in potential crop production, particularly in southern Africa, south Asia and

Mediterranean countries. Additionally, localised extreme events and conventional agricultural techniques are causing soil degradation. Estimates indicate that 38% of the land cultivated in the world has been already damaged by conventional agricultural practices, inducing soil compaction, loss of organic matter and erosion. Every minute, the world loses 3 ha. of arable land due to salinisation and alkalisation and approximately 25 million ha. of irrigated land has decreased productivity due to inappropriate and poor soil management.

Consequently, current research has concentrated on the recovery of degraded areas, especially in arid and semi-arid regions where soil desertification, soil salinisation and alkalisation are the major constraints. China has problems of salinisation on 23% of its land, Pakistan on 21%, India on 11% and Mexico on 10%.[2, 3] Moreover, this situation is not static, as each year approximately 1.5 million ha. of irrigated areas suffer from the salinity increase.

Figure 1. Mixing extruder for sulfur bio-fertilizer.

Figure 2. Sulfur pastilles at discharge.

Figure 3. Sulfur-bentonite pastilles.

Global assessments of land degradation estimate 15% of the world's total land area shows evidence of damage, mainly as a consequence of erosion, nutrient loss and physical compaction.[4] A recovery of saline or degraded soils for agricultural purposes is therefore necessary to prevent erosion, to restore fertility conditions and to increase productivity.

Degraded and alkaline lands suffer also from deficiency of sulfur, a major plant nutrient.

It is essential to identify intervention methods that can aid the recovery and reclamation of soils that are rich in salts or soils poor in organic matter. SBS plans to recover the soils that are characterised by alkalinity due to a high concentration of carbonates, through the use of sulfur. The sulfur will be used to remove any sodium absorbed on the colloids and to restore the sulfur concentration to levels necessary for plant mineral nutrition. The company's research objective is to determine the optimal doses of sulfur that can be used to lower the soil pH, decrease the carbonate content and fertilize the degraded land, in order to secure a sustainable recovery of soils and productive purposes. The sulfur used will be pelletised from the residues of the desulfurisation of oil and natural gas. It is well known that sulfur is used in high pH alkalic spots for its strong acidifying effect as well as its ability to replace sodium with calcium. However, it is difficult to apply its elemental form (S) as a fertilizer, since it is not soluble in water. For this reason, elemental sulfur will be alloyed with bentonite clay in the SBS plant, and slowly released into soil where the soil bacteria will transform it in sulfate-sulfur as chemical form, which is soluble in soil and easily taken up by plants.

In addition, this project intends to use locally sourced organic waste materials (agricultural wastes) to restore the fertility of degraded lands. Italy, after Spain, is the major citrus producing country of the Mediterranean Basin, with an area of more than 170 000 ha. and an average production of 3 million t over the last 5 years.[5]

In the last 20 years, the quantities of citrus produced has increased steadily, from an average of 351 000 t between 1971 and 1976 to 860 000 t in the last 5 years. This increase can be attributed mainly to the gradual collapse of exports and the consequent congestion of the internal market of the fresh fruit. As such, the processing industry has increasingly been called upon to play an important role in the cultivation of citrus. Italy processes approximately 800 000 tpy of fruit, and the consequent waste production amounts to approximately 500 000 tpy. Citrus peel and pulp mainly comprises:

- Water (75 – 85%).
- Mono- and disaccharides consisting of glucose, fructose and sucrose (6 – 8%).
- Polysaccharides such as pectin, proto-pectin, cellulose and hemicellulose (1.5 – 3%).
- Organic acids including citric, malic, isocitric (0.5 – 1.5%).
- Other substances with distinct biological properties such as vitamins, flavonoids, amino acids and minerals.

Such a composition of the waste products from citrus fruits offers ample opportunity of use, especially given the high level of nutritional components.[6] At present, only a small proportion of pulp is dried to be later used for the production of pectin or for use in the animal feed industry; the bulk of the product is disposed of in landfills.

This disposal of byproducts is a typical problem in Mediterranean countries, where more than 30 million m^3 of olive oil waste is produced, in both liquid (water of vegetation) and solid states. The organic material produced by the extraction of olive oil poses serious problems for disposal. The waste mills are characterised by a high presence of organically complex pollutants.[7] If released into the environment without the adoption of appropriate practices, such compounds can result in harm to the ecosystem, and precisely due to these possible environmental risks, the rules for the disposal of olive byproducts are very strict.

Figure 4. General view of pastillating area.

Figure 5. General view of refining plant.

Figure 6. Industrial extruder closed.

As such, SBS has begun working with Università Mediterranea of Reggio Calabria in order to develop a method to convert these wastes into a resource, which would reduce the disposal of biomass in landfills, promote profitable businesses and produce compost for a sustainable management of the whole soil ecosystem.

The new process will use sulfur, bentonite and bio-remainders. The components will be sourced from the following locations:

- Sulfur will be supplied from sulfur recovery units (SRU) in oil refining systems or from gas sweetening systems.
- Bio-remainders will come from agriculture and city bio-waste.
- Bentonite, a natural clay, will be sourced worldwide from diffused clay quarries.
- Other additives, such as rock phosphate, nitrate salts and sulfate salts, will be added to the fertilizers during production.

The SBS process consists of a continuous, fine-tuned blending system, complete with a pastillation unit, which is able to produce small pellets that can be integrated into continuous production lines.

The company envisages cooperation with local agronomic experts to formulate custom fertilizers using local wastes, which could make nutrients necessary for the local lands available to the local cultivators. Additional plans include the design of turn-key plants for the local production of sulfur bio-fertilizers. SBS is also ready to cooperate with agronomic entities to integrate the use of such new fertilizers into the local agronomic communities. WF

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