VALORISATION OF BIOBASED SIDESTREAMS IN AGRICULTURE

INTERVIEW WITH ALESSANDRO ARIOLI

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CASE STUDY: ORGANIC SIDESTREAMS IN AGRICULTURE

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CIRCULAR ECONOMY AND BIOMASS: DISTINGUISHING BETWEEN RESIDUE AND WASTE

Within the circular economy, a significant niche is the circularity of biomass. Biomass is a broad term encompassing materials containing organic carbon. Biomass is the result of complex biochemical reactions involving living organisms throughout the production chain. Biomass classified as residues or waste exhibits great diversity, and its classification can vary significantly depending on local context and economic interpretations.The classification of a biomass as a 'residue' or 'waste' is influenced by logistical factors, such as the availability of treatment infrastructure, and socio-cultural factors, including consumption habits and local perceptions. The term 'biomass' is both global and local, as its practical application varies according to cultural and geographical context. For example, the composition of municipal solid waste varies significantly depending on latitude and longitude. This is particularly evident in Africa, a continent we have extensively studied through numerous projects covering over two-thirds of African countries. We have a vast dataset on the composition of municipal solid waste in cities, which shows a clear predominance of minimally processed organic material. In contrast, in residential areas, metropolises, and megalopolises, while a significant organic component persists, we observe a significant increase in other fractions, particularly plastics and inorganic materials. In these contexts, municipal solid waste is characterized by a greater variety and a lower organic component compared to rural areas.

BIOMASS VALORIZATION CASE STUDY

A prime example of a comprehensive approach to biomass valorization is anaerobic digestion. Anaerobic digesters, often likened to artificial rumens, are enclosed systems consisting of large bioreactors typically recognized by their dome-shaped structures. These vessels, often made of plastic, expand due to biogas production, primarily methane, and can reach considerable sizes, resembling large circus tents. Anaerobic digesters are frequently installed in batteries, or groups of units operating in coordination. Over a cycle lasting five to eight weeks, these systems utilize anaerobic fermentation to treat organic materials, offering a sustainable solution to the complex problem of managing livestock waste. Untreated livestock manure releases significant amounts of greenhouse gases into the atmosphere, contributing to the greenhouse effect. Anaerobic fermentation offers two major advantages. Firstly, it produces biogas, with 50-60% of the organic matter being converted into methane, the main component of biogas. This biogas can be used as a fuel in gas engines, similar to those powered by LPG or purified methane, used in automobiles.
During the process, the hydrogen and carbon atoms present in the residual biomass (a material resembling a dense cream) are converted into biogas. The residue of this process, called digestate, is much more stable and less polluting than the initial biomass. If the biomass had not been treated, it would have released significant amounts of greenhouse gases into the atmosphere.
Another issue related to the disposal of livestock manure and digestate is the percolation into the groundwater, with the risk of contaminating aquifers. To mitigate this risk, regional Agricultural Use Plans (PUA) are in place in Italy. These plans, based on soil characteristics (permeability, geological composition), define the maximum amounts of manure and digestate that can be spread on fields, thus preventing groundwater contamination.
The liquid fraction of digestate, separated from the solid fraction through centrifugation, is rich in nutrients and can be distributed in fields through irrigation systems, providing crops with the necessary minerals for healthy growth. Additionally, the microbial component present in the digestate improves soil fertility, benefiting future crops.
The solid fraction of digestate, separated from the liquid fraction through centrifugation, is primarily composed of undigested plant fibers. These fibers, originating from animal feed, especially cattle, are largely indigestible even by the microorganisms present in biodigesters. Therefore, they accumulate in the final solid residue. This solid fraction can be further valorized through compaction and compression processes. In this way, pellets or briquettes are obtained, solid fuels ideal for pellet or wood stoves. This is a completely natural fuel.
We have seen how the management of a problem, such as the disposal of livestock waste, can create two valuable opportunities: the production of biogas and the valorization of digestate as a fertilizer. The latter, in particular, represents a remarkable resource for agriculture, as it can almost completely replace synthetic chemical fertilizers. An analysis of the chemical composition of digestate shows that it contains all the nutrients necessary for plant growth. Therefore, its use in agriculture not only improves soil fertility but also reduces the environmental impact associated with the production and use of synthetic fertilizers.
In many cases, careful management of the biogas plant and related farms has allowed for the complete elimination of the purchase of chemical fertilizers, demonstrating how anaerobic digestion technology can contribute

to the creation of more sustainable and circular agricultural systems.
Anaerobic digesters have experienced significant growth, especially in rural areas, where the availability of biomass as a byproduct of agricultural activities makes them particularly advantageous. Currently, there is a good balance between the demand for biogas and the supply, thanks also to the need to constantly supply these plants with an adequate quantity of quality biomass.