HYST TECHNOLOGY : PRINCIPLES AND AREAS OF APPLICATION

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HYST SYSTEM

Hyst is a system designed to treat plant material through physical action.

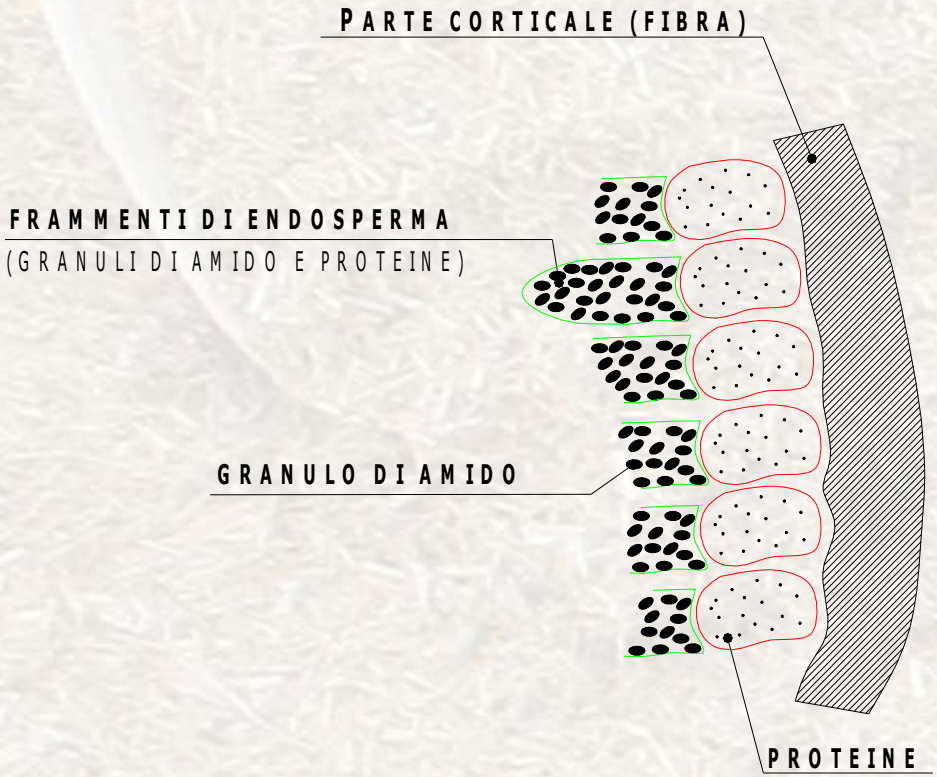
It consists of two main components: disaggregators *(3, 4)* and separators *(G, M, F4, 6)*.

In the former the structure of the material is broken down via *collision* and *resonance crushing* processes.

In the latter the various components of the material are separated. The larger and heavier fragments are extracted first (G and M). The finer material is extracted from the end sections (F4).

The material is carried through the various sections of the device by the air flow generated by a special blower (7).

DISAGGREGATION PROCESSES



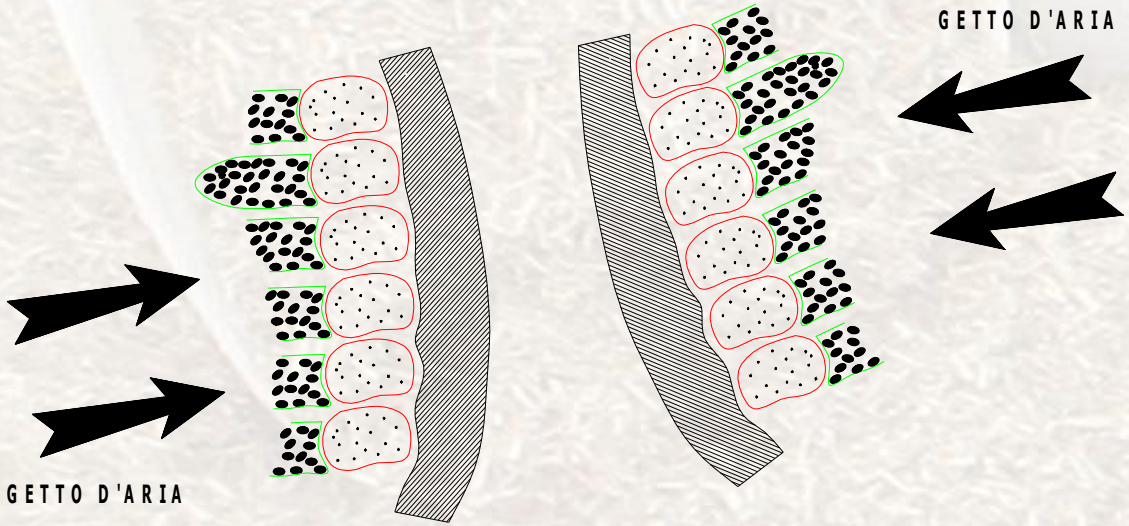
1) wheat bran is composed of:

an **external layer of fiber** clusters

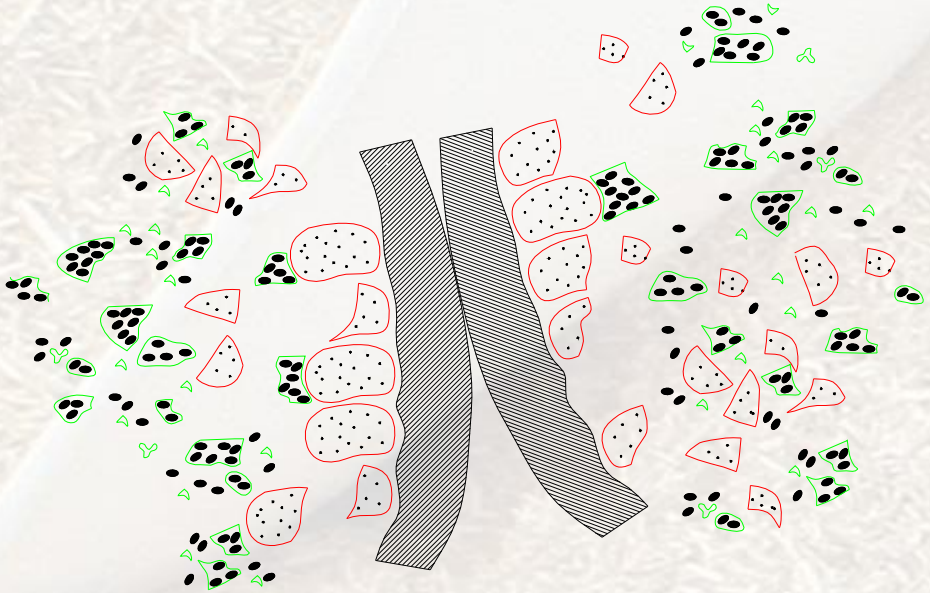
a layer of **aleurone cells** (proteins, shown in red), firmly attached to the fiber

fragments of the endosperm (in green) composed of starch granules bound together by a matrix of proteins.

DISAGGREGATION VIA COLLISION

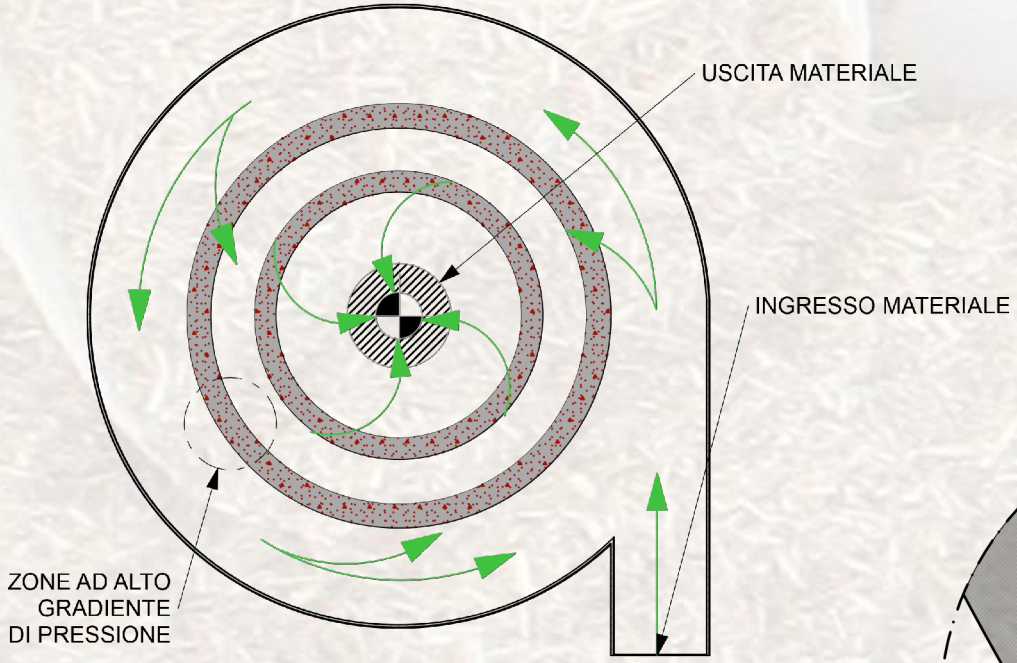


2) high speed air flows (up to 1000 km/h) cause the collision of the outer layers of bran

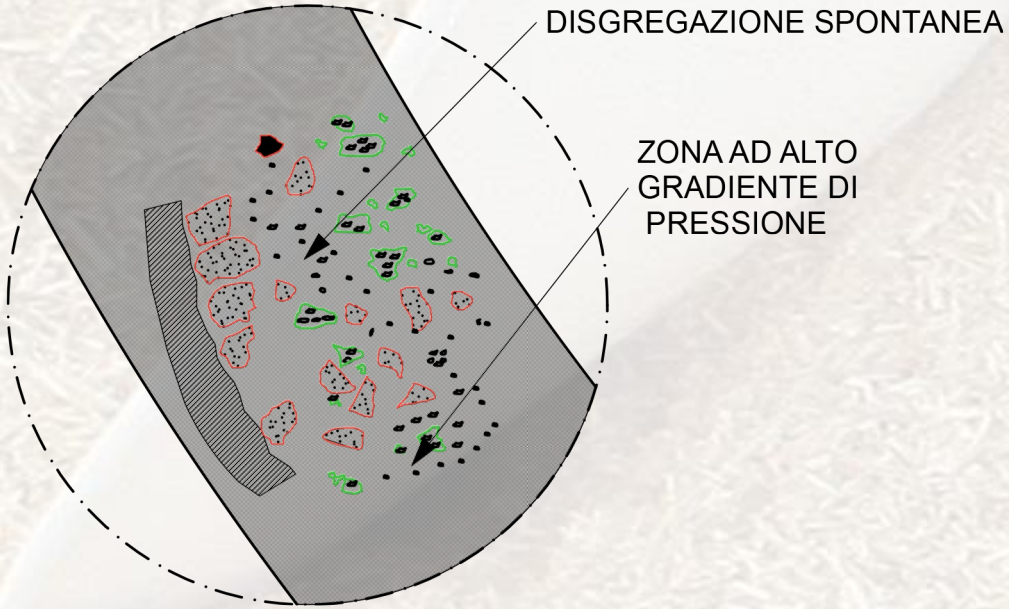


3) during collision the fibrous part (more elastic) remains mostly intact, while the internal parts (more brittle) fragment and become separated from the fiber.

DISAGGREGATION VIA RESONANCE

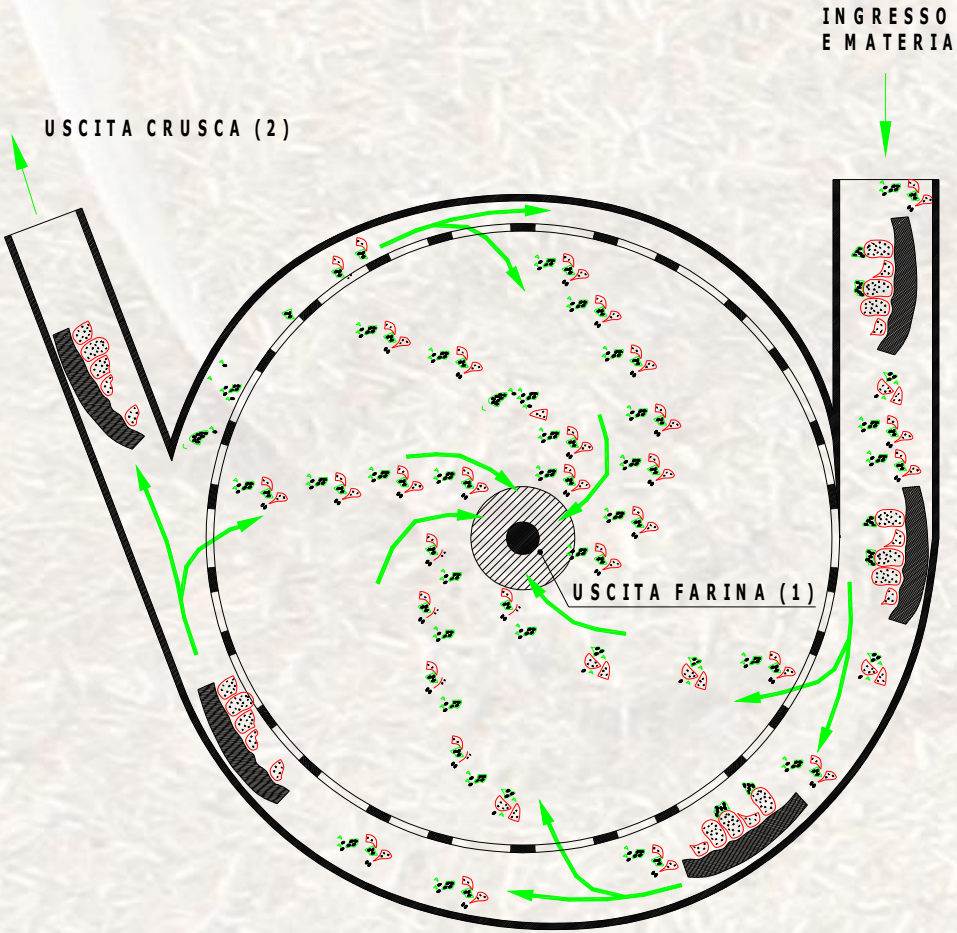


4) the material is circulated at low speed (40-60 m/s) in the appropriate circular rooms, where zones with high pressure gradients are created



5) when the external layers enter the high pressure gradient zone spontaneous disaggregation takes place along the fracture lines caused by the previous processes

CLASSIFICATION



6) Fragments and air at high speed (green arrows) are introduced into the separation device and made to spin in a circular motion.

The air carries the smaller fragments (starch and proteins) to the central exit, while large fragments of bran are maintained in the periphery by centrifugal forces, thus causing them to separate.

THE HYST SYSTEM AND BIOFUELS

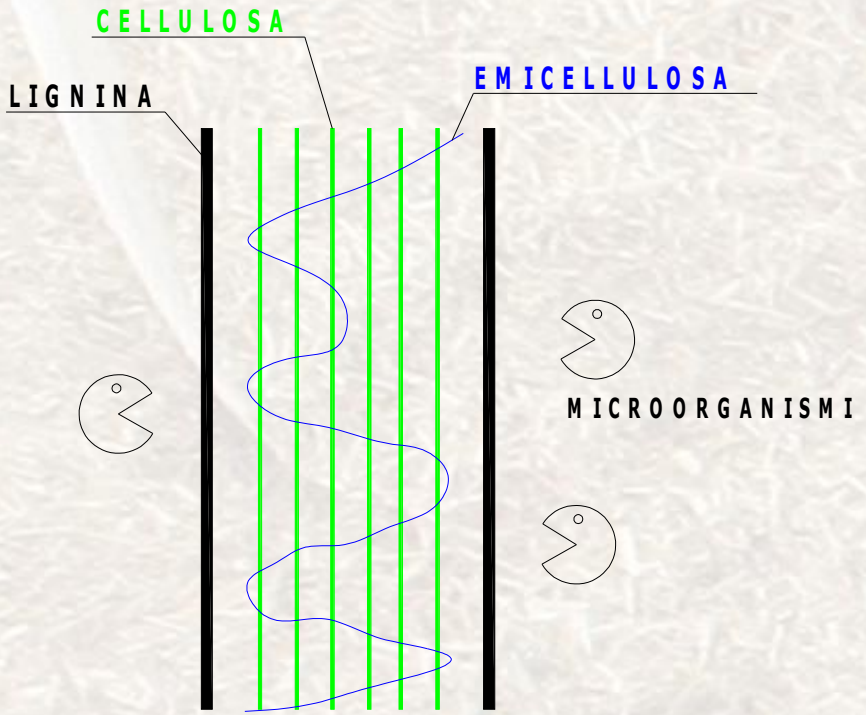
Biofuels such as bio-methane and ethanol are generally produced from two types of plant material:

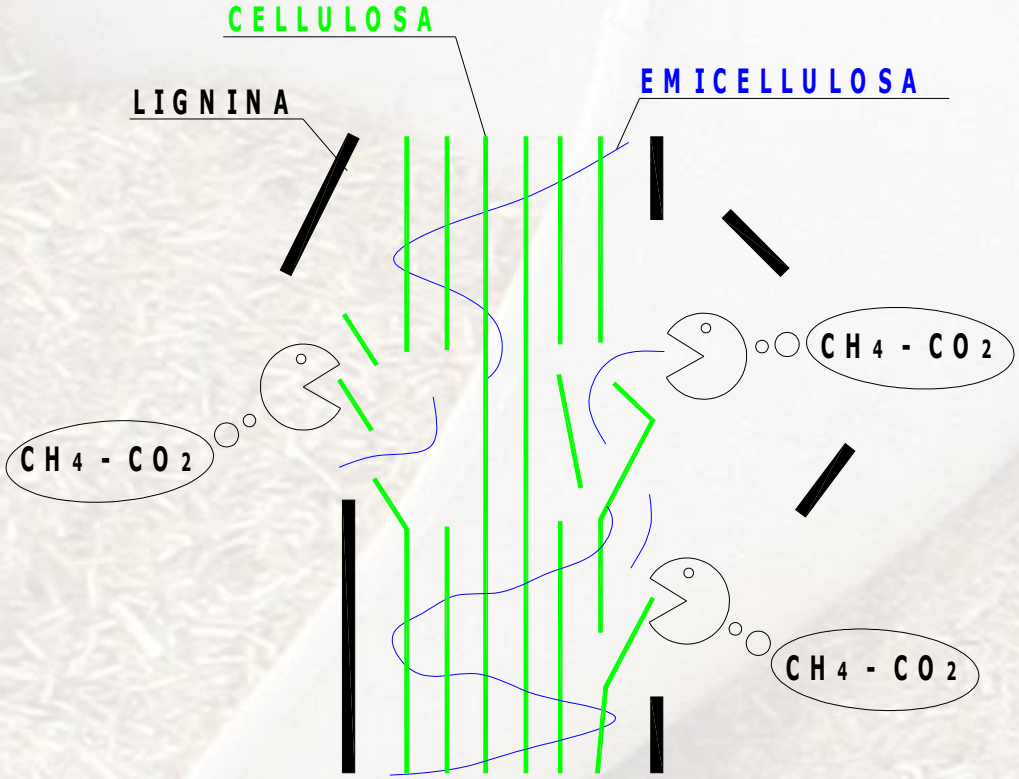
- cereals, easily used by microorganisms, since rich in starch and easily digestable;
- agricultural residues (lignocellulosic materials), used with difficulty by microorganisms.

Agricultural residues, however, need to be appropriately modified to make them usable by microorganisms that turn them into methane and ethanol. This process is called PRETREATMENT.

The pretreatment phase is crucial for the effectiveness of the entire process. Indeed, the absence of industrially mature pretreatment technologies prevents, to date, the production of commercial volumes of second generation fuels.

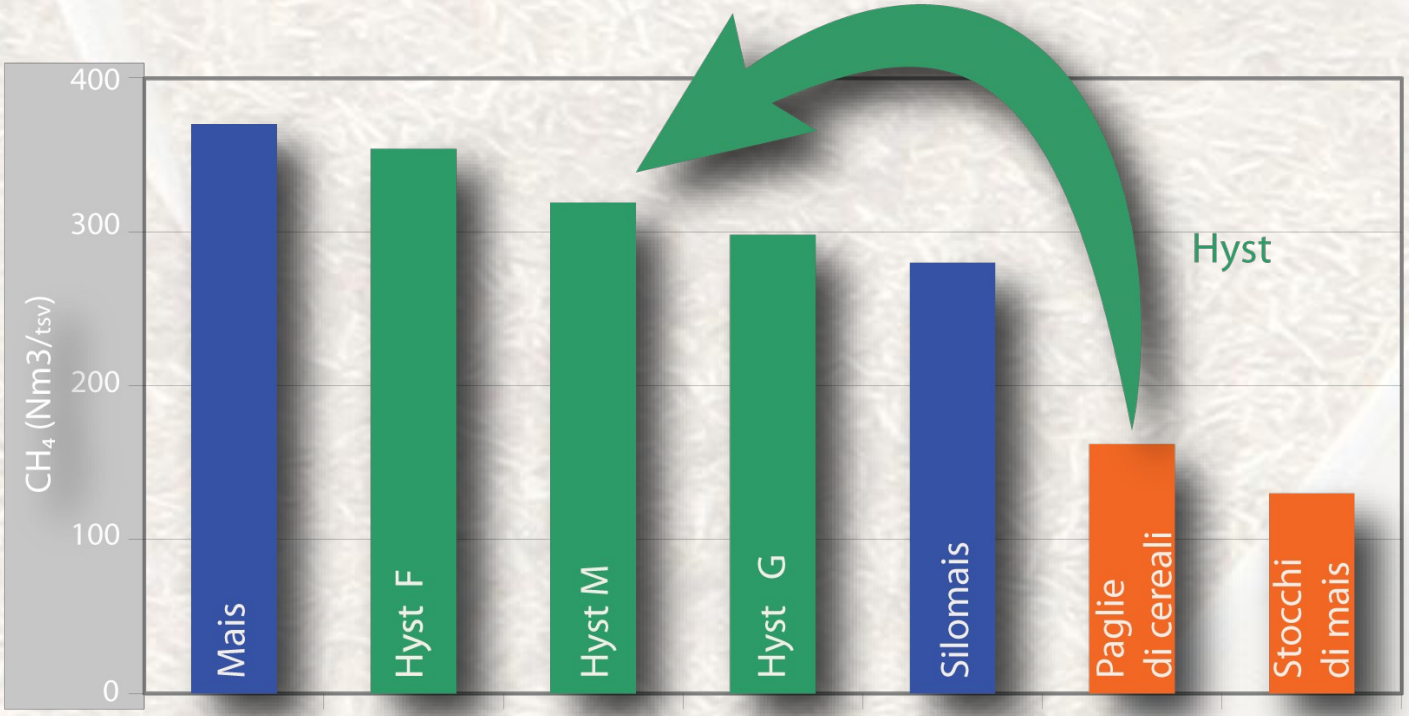
HYST PRETREATMENT





The disaggregation processes break down the shield of lignin allowing microorganisms to access the digestable carbohydrates (cellulose and hemicellulose). Furthermore, these carbohydrates are fragmented and therefore made more easily usable.

HYST PRETREATMENT: RESULTS

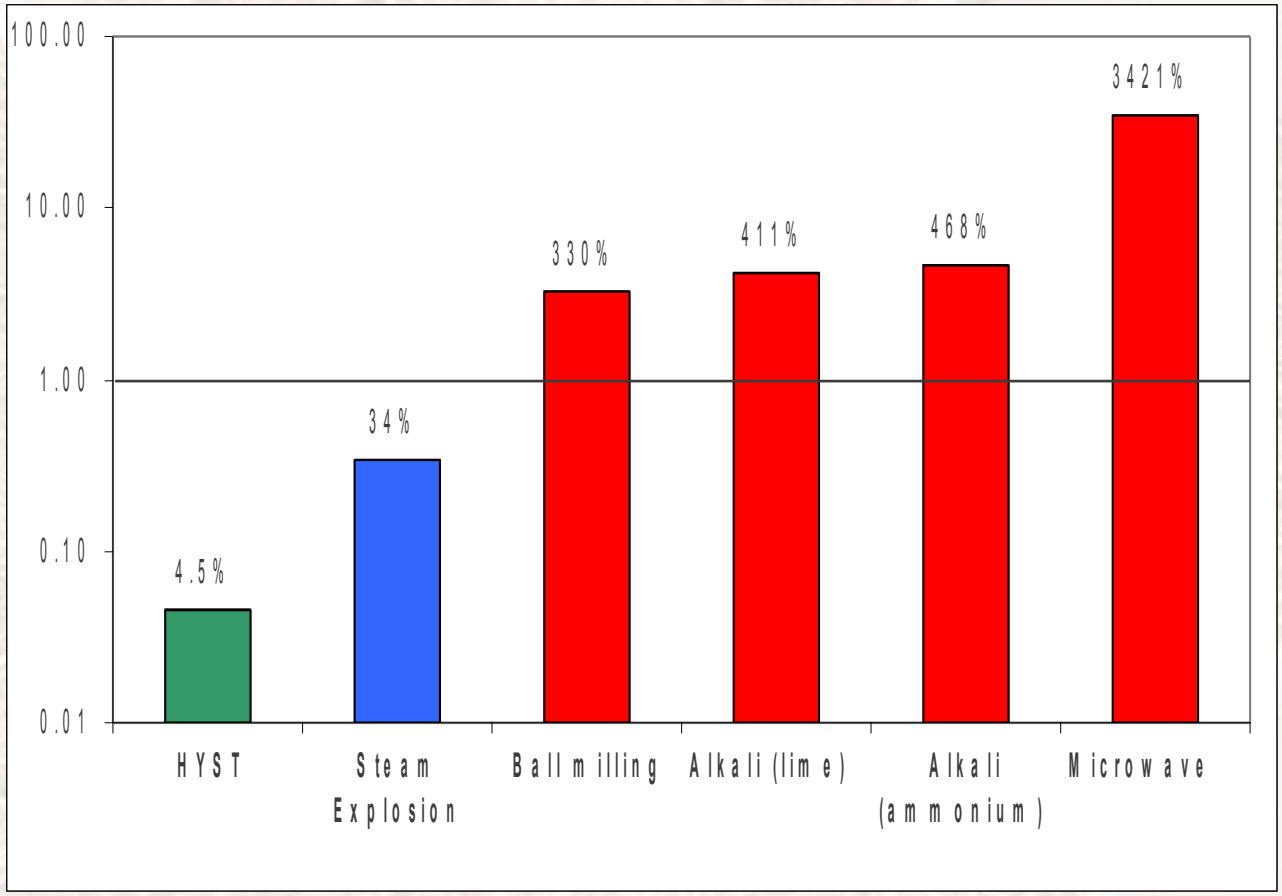


Cereal straws subjected to Hyst pretreatment double their production of methane.

The finer fractions show a conversion yield similar to that of cereals.

Effect of Hyst treatment on the production of bio-methane (Nm^3/t_{VS}) from straw through anaerobic digestion.

HYST PRETREATMENT: EFFICIENCY



Comparing pretreatment technologies: ratio between the energy required for pretreatment (Energy Input) and that obtained from the methane produced (Energy Output).

A fundamental parameter for the industrial use of a pretreatment system is energy efficiency.

The Hyst process consumes only 4% of the energy generated from the combustion of the methane produced.

HYST improves by an order of magnitude the energy performance of the most advanced pretreatment systems available today (*steam explosion*).

HYST: FOOD **AND** ENERGY

One of the key features of the Hyst system is the use of agricultural residues for both food and energy purposes.

The finer fractions have a decidedly higher nutritional value compared to the raw material and can be conveniently used as animal feed.

The coarser fractions can be conveniently used for energy purposes.