



“ATTRITOR MILL” TECHNOLOGY AND GASIFICATION TEST RESULT

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INTRODUCTION

The present study was established under the Agreement on scientific cooperation signed between the "DIMA - Department of Mechanical and Aerospace Engineering" University "Sapienza" of Rome and the Municipality of Roccaraso signed on 25 June 2013.

This agreement provides for a scientific collaboration aimed carrying out research in the field of energy recovery and utilization of waste.

In particular, the research presented in this document relate to the performance of experimental tests for the use of high quality SRF - Solid Recovered Fuel - obtained through the experimental mechanochemical plant named "ATTRITOR MILL", installed in the city of Roccaraso, within an experimental gasifier made in the laboratory of DIMA.

THE SRF - SOLID RECOVERED FUEL

The SRF or Solid Recovered Fuel, for their particular qualities described by a European standard, arising from the standpoint of environment and energy as a viable alternative to using traditional fuels, reducing procurement costs.

In summary SRF are:

- non-hazardous waste;
- heterogeneous solid fuels;
- are obtained from municipal waste.

The SRF is classified according to three parameters:

- the lower heating value: indicator on the market of the SRF, as representative of the energy and economic value;
- the content of chlorine: describes the index of aggressiveness on plants;
- the content of mercury: indicator of the environmental impact of the waste.



THE TECHNOLOGY: ATTRITOR MILL

The “ATTRITOR MILL” is a new tested technology used to convert waste in fuel: **HIGH QUALITY SRF –Solid Recovered Fuel**.

The hearth of the process is the waste micronization, called “*mechanochemical technology*”.

The *mechanochemical technology* stems from the experience of the last twenty years on new materials and unorthodox treatments of metals, aimed at obtaining alloys and ceramic materials with very high resistance but without the use of thermal energy and using mechanical energy transferred to matter through a normal "mill" that exerts a "comminution", ie a progressive reduction in the size of the material.

The action of micronization takes place through friction and impact exerting pressure (from 8,000 to 15,000 atmospheres) so as to destroy any bacterial flora (thus eliminating odors and fermentation), and thus make the product sterile, completely dehydrated (the water is vaporized) and always free from chlorine, sulfates and aggregates.

By this technology is possible to obtain:

- ✓ **Reduction in volume** by approximately **70%**;
- ✓ **Reduction in weight** of around **50%**;
- ✓ **Reduction of the bacterial load**;
- ✓ **Increase of the heat of combustion** of the waste up to about **80%**.

The environmental impact during processing is almost zero, in fact:

- ✓ Do not use hot processes;
- ✓ Do not use chemical additives;
- ✓ The only possible form of emission is water vapor;
- ✓ Does not produce odors, volatile or microparticles, or dioxin, or any kind of pollutant in the air, water and soil;
- ✓ Low energy consumption;



- ✓ Lack of water consumption;
- ✓ Does not produce eluates, being treated waste daily.

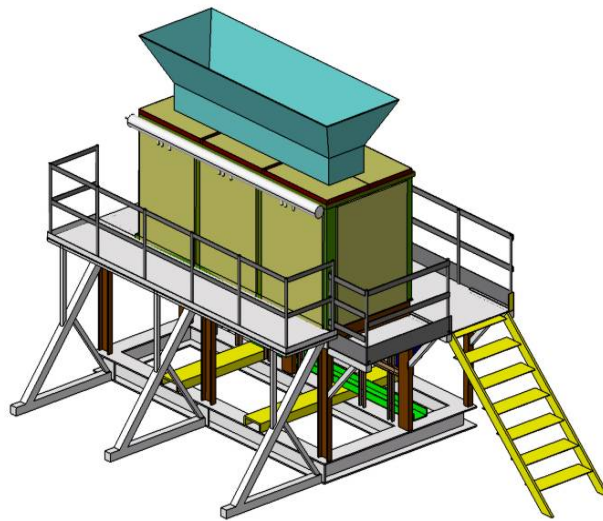


Figure 1 Picture of the plant ATTRITOR MILL

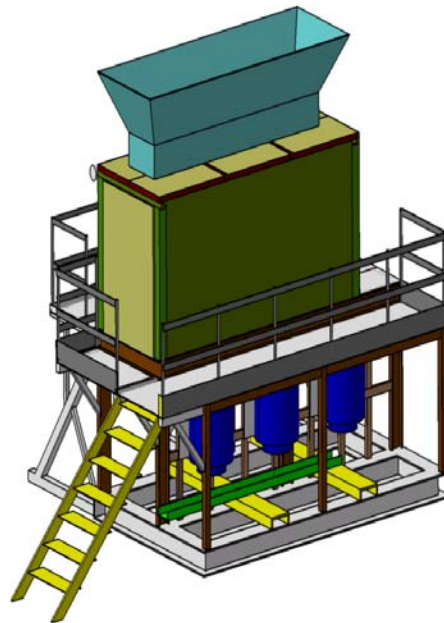


Figure 2 Picture of the plant ATTRITOR MILL



The ATTRITOR MILL system lets you to turn the treated waste into SRF, eliminating the bacterial load, reducing humidity to values around 5% and give it a minute and regular geometry, possibly compacted pellets. The SRF is no longer classified as waste but it becomes fuel.

INNOVATIVE SOLUTION

A very interesting solution is to put the plant "ATTRITOR MILL" within a platform that provides a waste stages processing and is divided for simplicity into 3 stages:

STAGE I - Mechanical treatment: allow to prepare the waste for next processing.

STAGE II - Mechanochemical refining by "Attritor MILL": in this stage waste turns into high quality SRF, eliminating much of the residual moisture and bacteria.

STAGE III - Enhancement Power: The SRF product can be used for the combined production of electricity and heat power energy.

Thanks to this configuration is possible to recover ferrous and non-ferrous metals, glass and inert waste by reducing waste to landfills up to about 5%;

ENERGY PRODUCTION ESTIMATION

Here are some estimations about electricity production based on the following assumption:

- Medium value of 1 kg/day per person of waste generated; 1 ton each 1000 persons;
- Medium lower heating value of SRF : 20MJ/kg;
- Conversion of energy system: 20%

	Number of inhabitants			
	1000,00	10000,00	100000,00	1000000,00
Nominal electrical power output (MWp)	0,045	0,45	4,50	45,00

Table 1 Estimation of nominal electrical power output based on number of inhabitants

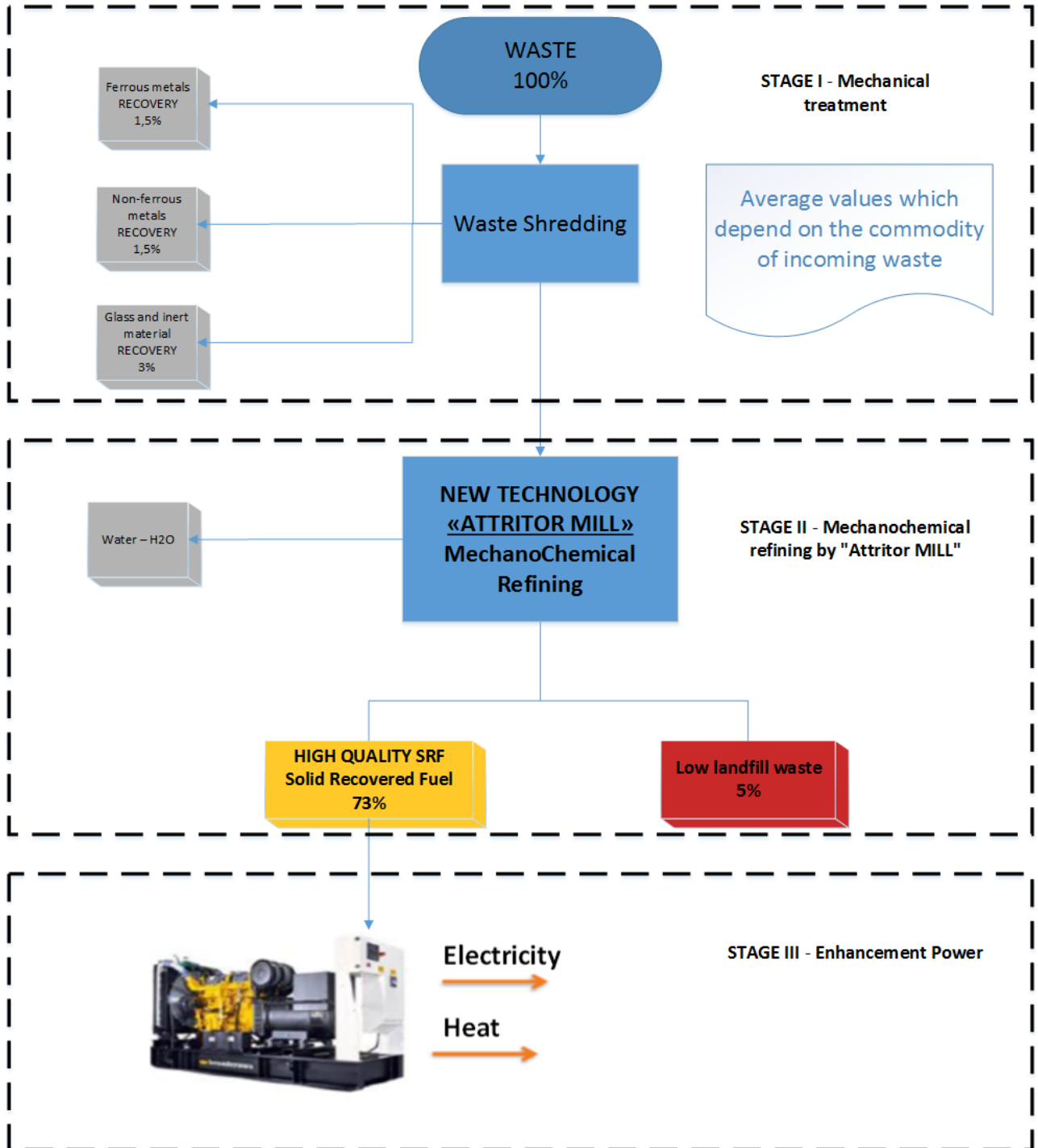


Figure 4 Process block diagram



SRF GASIFICATION TEST RESULT

The Department of Mechanical and Aerospace Engineering of "Sapienza University of Rome" has validated the technology "ATTRITOR MILL" and has tested the SRF produced by the plant in a gasification process.



The analysis conducted on the syngas were compared with those obtained from the gasification of woody biomass and the results were excellent.

Briefly it may be said that the syngas has:

- ✓ **higher H₂ content;**
- ✓ **lower CO content;**
- ✓ **Better composition of the TAR - Topping Aromatic Residue**