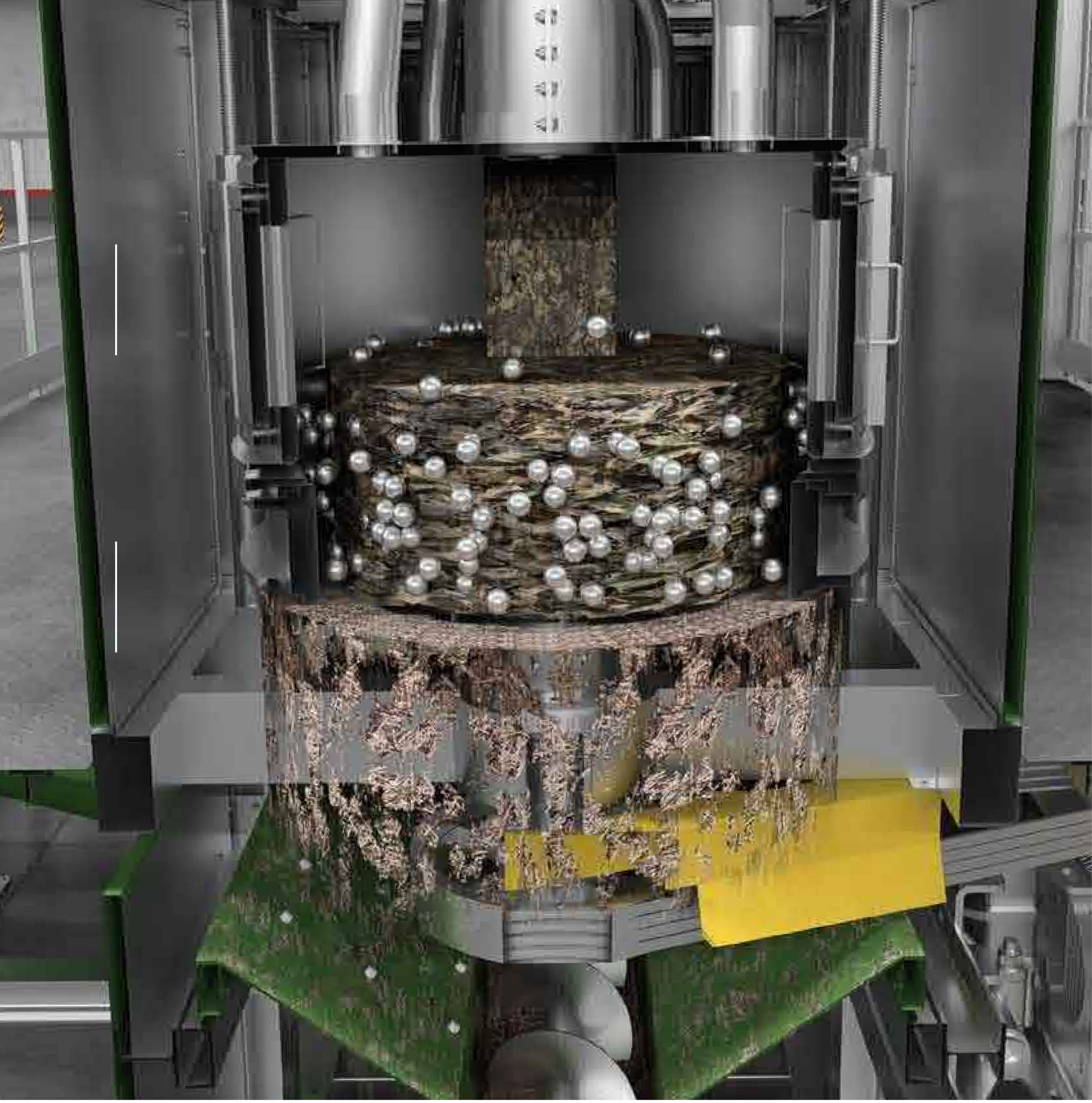
attritormill

attritormill HYBRID

The unique solution for waste micronisation



Executive summary

AttritorMill is a machinery with innovative and exclusive features, which can process selected waste from mechanical treatment, through a mechano-chemical technology that through a micronisation process, alters its molecular structure, with a dramatic improvement in output, at extremely low operating costs

AttritorMill

Main features & advantages

Unsorted Waste	Sorted DRY WASTE	Sorted ORGANIC WASTE
Production of RDF End of Waste **UNI CEN 15359** **Compliant**	**Production of RDF** End of Waste **UNI CEN 15359** **Compliant**	**Sanitisation** **Organic Fraction**
Weight reduction From **20%** to **30%**	**Weight reduction** From **15%** to **20%**	**Weight reduction** From **35%** to **45%**
Reduction in volume **50%** with output size <15mm	**Reduction in volume** **50-60%** with output size <15mm	**Reduction in volume** **50-60%** with output size <15mm
4G plant Treatment Capacity **10t/h**	**4G plant Treatment Capacity** **8-9t/h**	**4G plant Treatment Capacity** **10-12t/h**

Technology

The patented AttritorMill technology is designed to transfer high kinetic energy onto the treated waste.

The treatment is achieved by a system of grinding masses made of highly impact-resistant material that are thrown at extremely fast speed.

In the Hybrid model, the grinding chamber is also equipped with a blade system upstream of the spheres.

The physical values characterising this system were determined through parametric investigations.

It was proven that the sum of the mechanical actions imposed by the grinding masses spheres spreads a very large number of structural defects in the waste, resulting in the progressive and irrecoverable destruction of the structure at the molecular level, generating the formation of microstructures with very special properties.
The grinding masses ensure impact and high shear.

The Plant

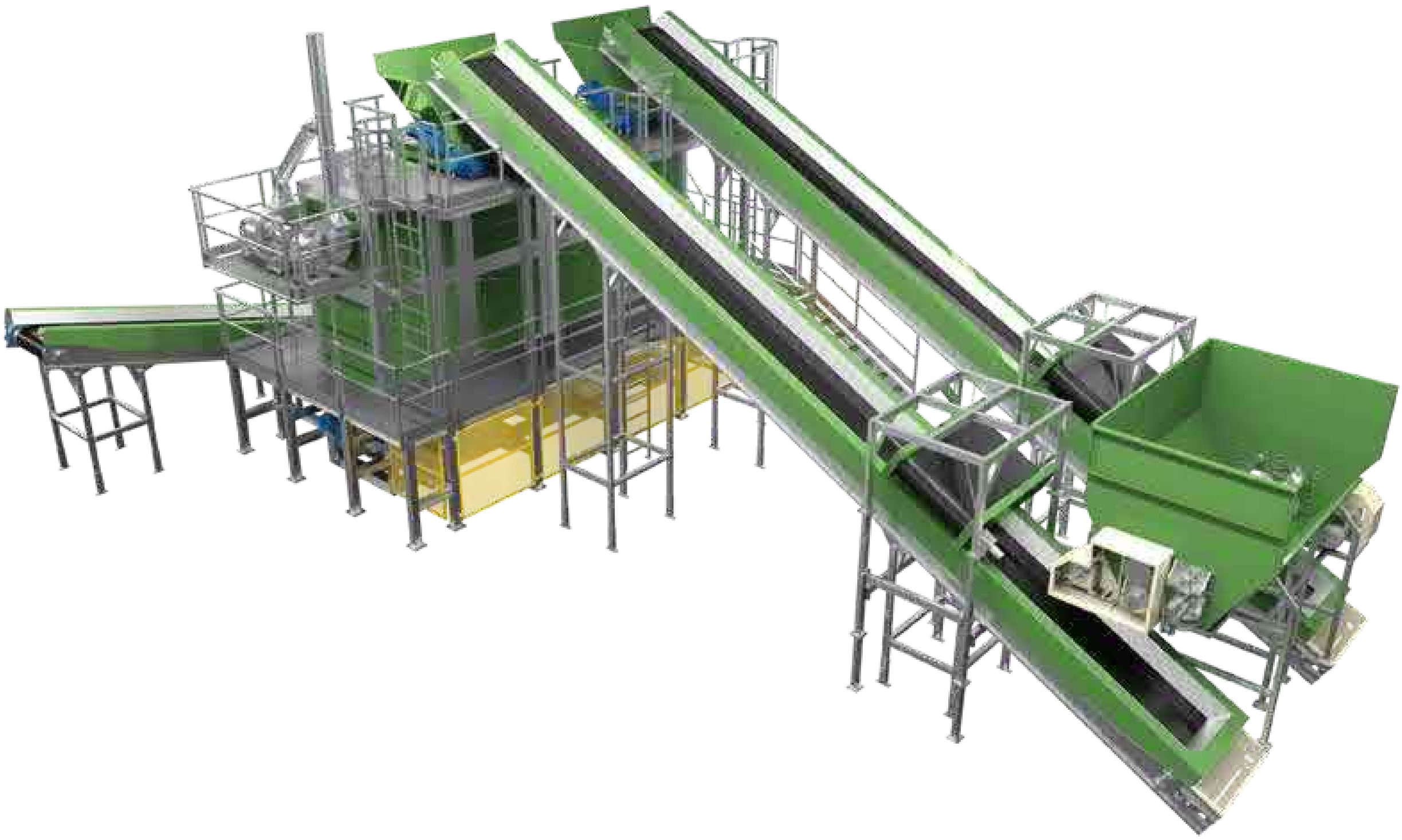
AttritorMill uses the heat generated by the friction of the grinding masses to stabilise and standardise waste.

Compared to other waste treatment systems, it brings considerable advantages in operating costs, volume and weight reduction, as well as in terms of time for stabilising the Organic Fraction.

Moreover, the output of the treatment, with a size of 10-15mm, is classified as RDF (according to UNI EN 15359/2011) and can be exploited in specific plants such as cement factories and power plants, by using it as a solid fuel for energy production.

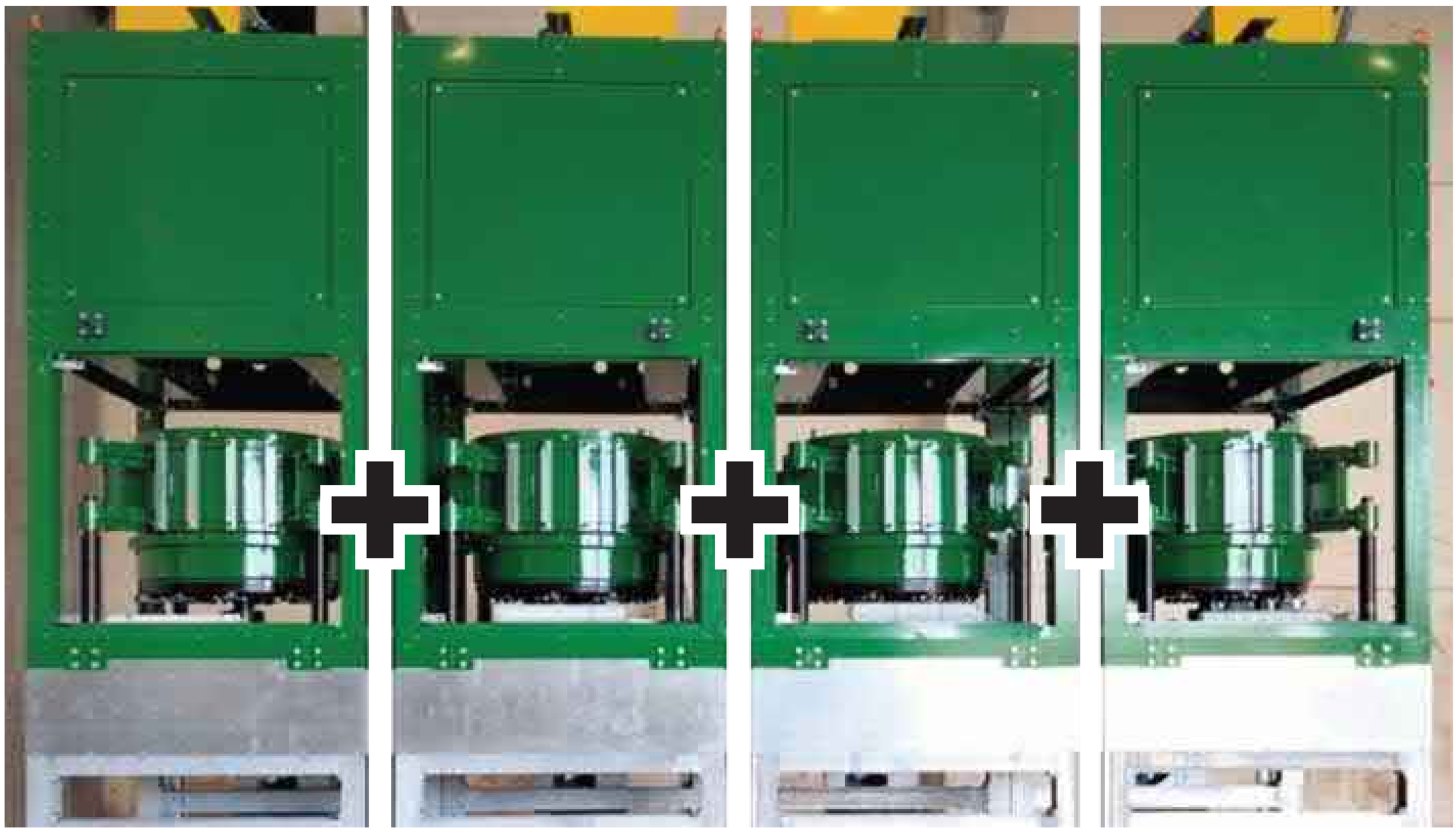
RDF is classified as End of Waste, therefore ceases to be waste and is turned into a Product.

The parts most exposed to wear and tear are made of special steels and are engineered to be used on both surfaces: therefore, once the first surface is worn out, they are turned over, doubling their useful life.



Modularity

The AttritorMill plant consists of one or more independent (individually operable) treatment chambers that can be integrated to meet the process requirements of each operator.



The perfect solution for waste treatment

AttritorMill is the ideal solution for the refining of waste, either from waste sorting or unsorted.

AttritorMill integrates perfectly into existing plants and optimises their production cycle, resulting in the transformation of waste in RDF, or RDF End of Waste.

In addition, it drastically reduces organic waste stabilisation times. All, with lower energy costs 32 kWh/ton.

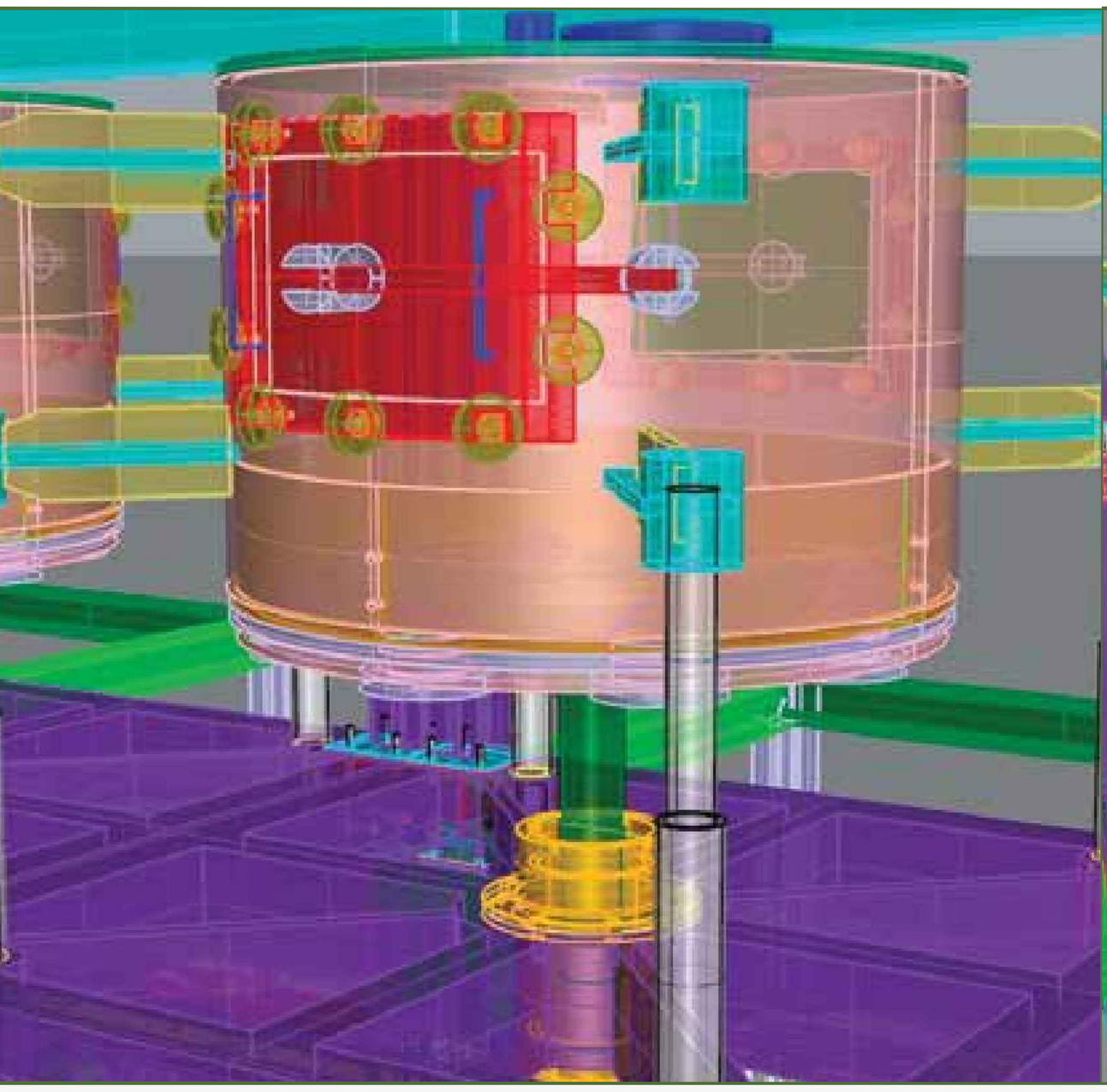
No thermal process

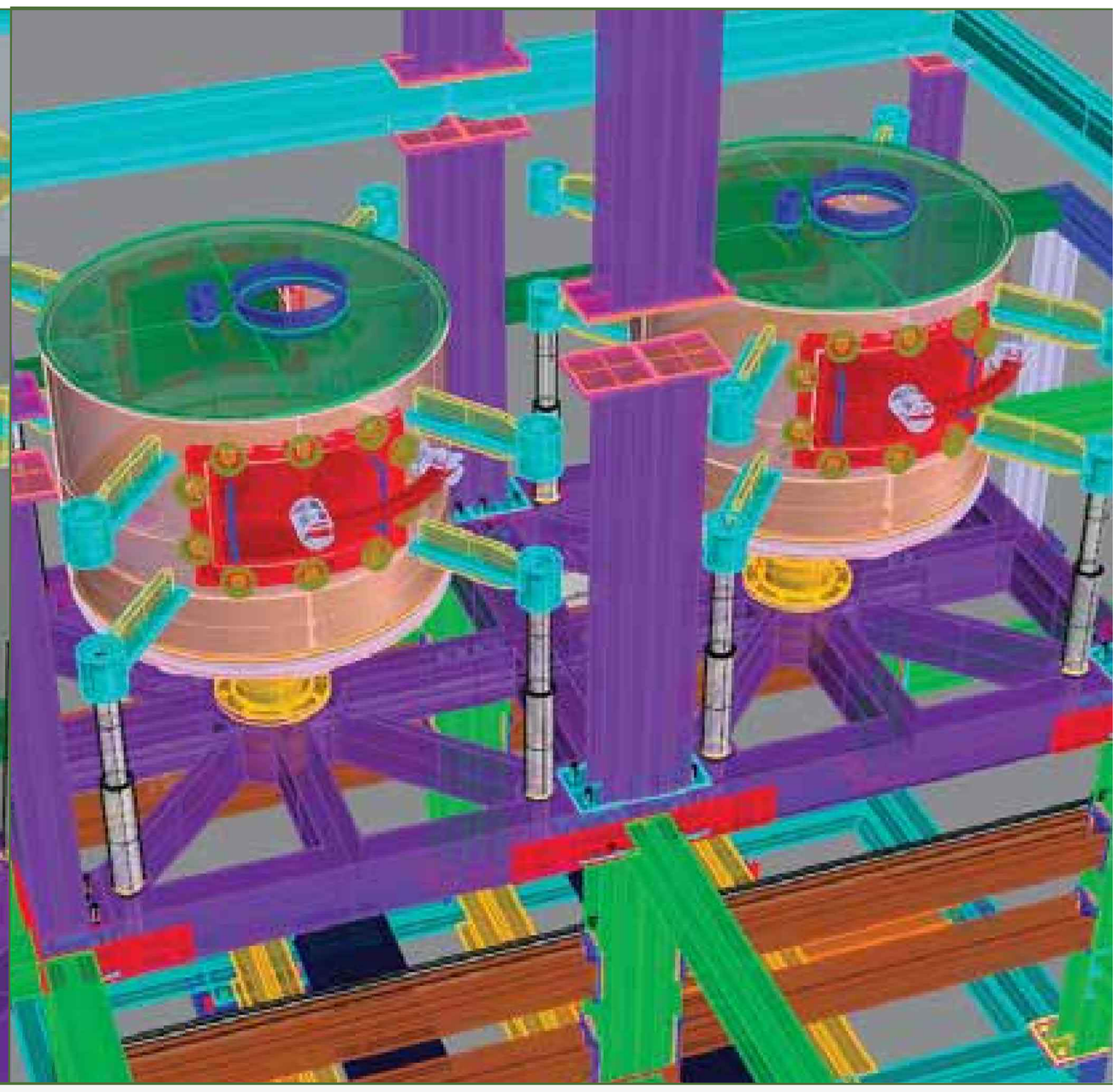
No water consumption

No chemicals

No eluates

odour reduction





Micronisation

Physics of Treatment

AttritorMill It is the world's first industrially available mechano-chemical mill that works continuously.

Until 2008, it was an experimental technology tested in laboratories only, never realised on an industrial scale.

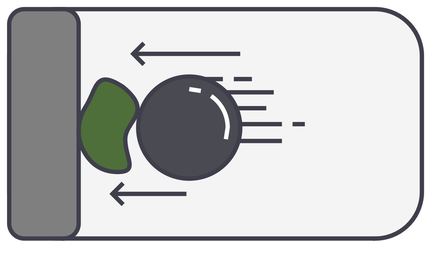
Our efforts enabled the design and realisation of the first industrial production machines based on the principle of grinding by friction and impact.

AttritorMill was developed by professionals, in cooperation with leading public research institutes, to develop the most modern methodologies for waste treatment.

The physics of the new micronising system grinds by means of special grinding masses of different diameters, which are thrown at high speed onto the waste particles.

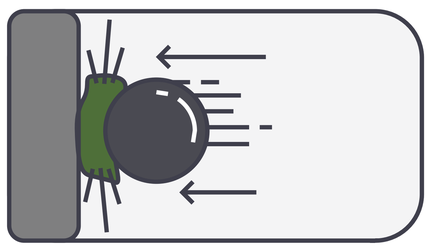
The grinding masses move at speeds of several tens of metres/s, encountering the waste particles and fragments.

1



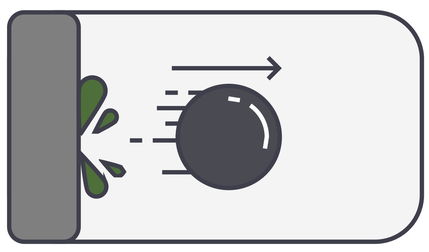
The grinding masses diffuse a large number of structural defects onto the waste, resulting in the formation of nanostructures with very special properties.

2



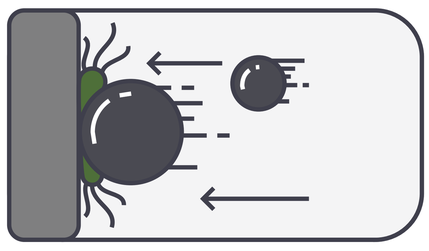
The impact of the grinding masses causes the water in the waste to be expelled in the form of steam (dewatering effect).

3



The pressure generated by the grinding masses on the waste increases the yield of «cracking», i.e. the breaking of macromolecules into simpler molecules.

4



The temperature inside the grinding chamber reaches 80° to 90°C, increasing the evaporation and exchange surface of the material and thus accelerating the sanitising processes.

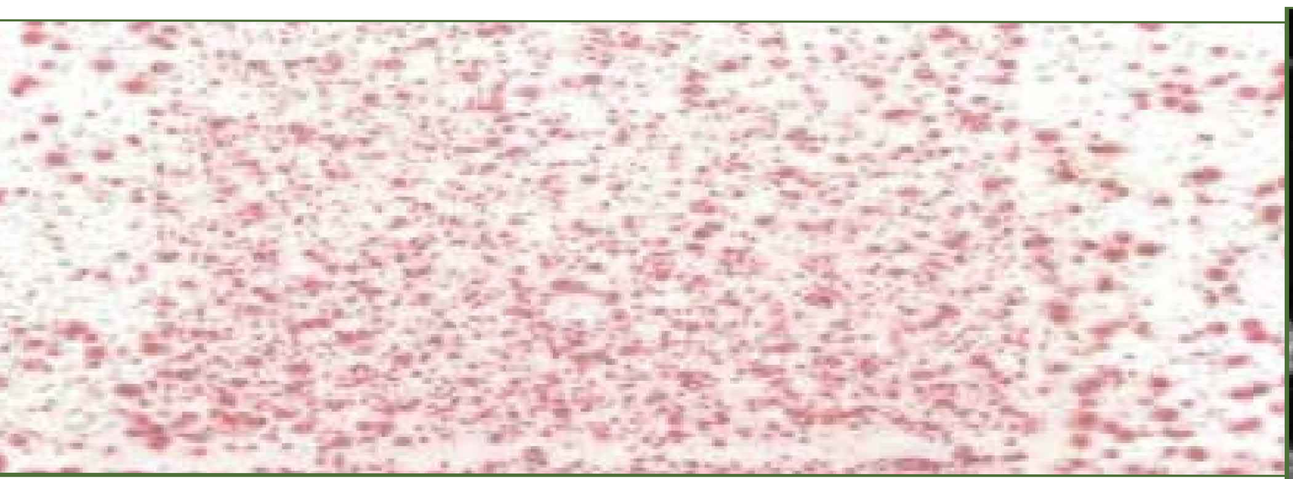
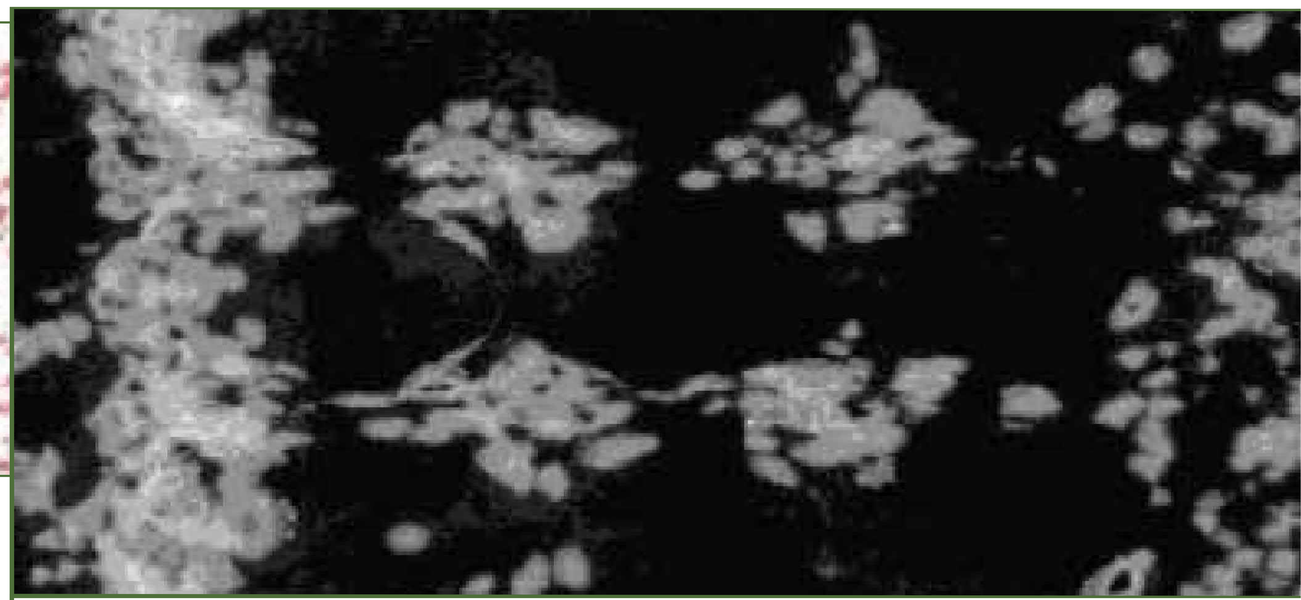


Illustration of the points where the spheres transferred their kinetic energy, reaching impact pressures of over 200 MPa



The grey tone scale from 0 to 200 MPa

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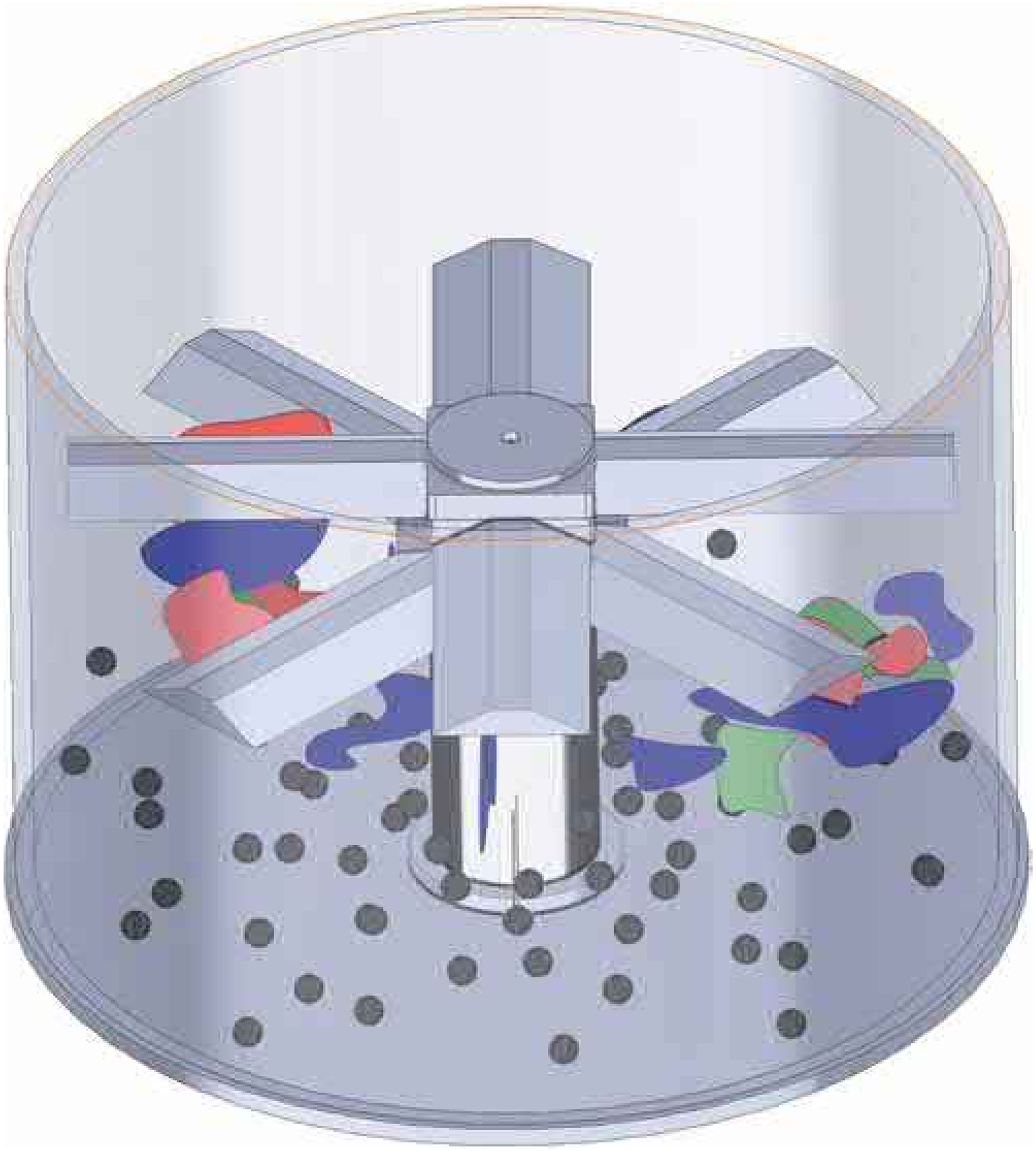


*The **hybrid** model, a system of blades is integrated in the grinding chambers upstream of the section in which the grinding masses operate*

Effects of AttritorMill processing

The simultaneous reduction in weight, volume and acceleration of the biostabilisation phase makes AttritorMill unique in the waste treatment plant market.

Moreover, its use results in an overall reduction in indirect operating costs, energy and surface area used per tonne of waste treated. The simultaneous and multifaceted performance of the AttritorMill plant allows it to achieve, almost instantaneously and with minimal impacts and costs, the goals that traditional Mechanical Biological Treatment plants achieve with high costs and impacts and much longer processing times.

Specifications of the RDF produced with AttritorMill

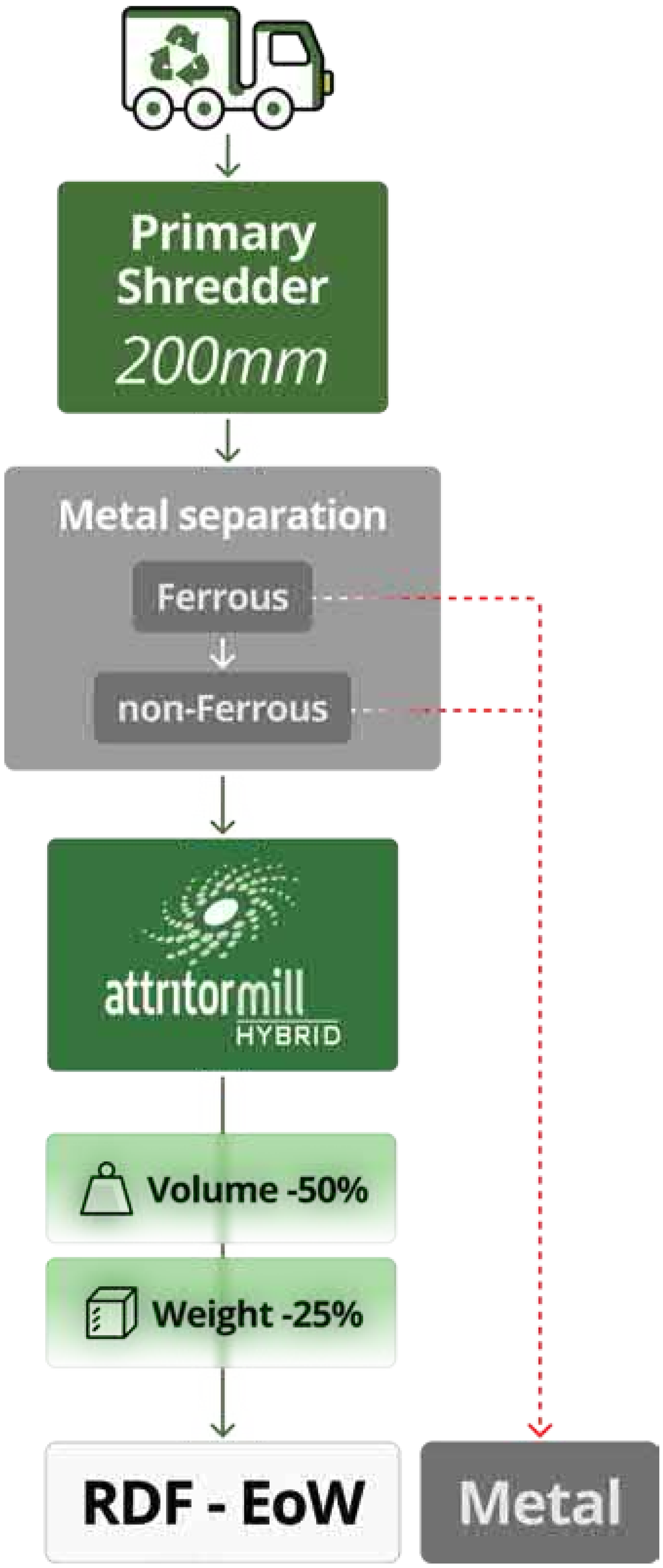
RDF produced with AttritorMill meets EU's most strict regulations set by the Waste Framework Directive (2008/98/EC), a key piece of EU legislation on waste management, which sets the basic concepts and definitions related to waste and introduces the waste hierarchy.

European Environment Agency

European Commission

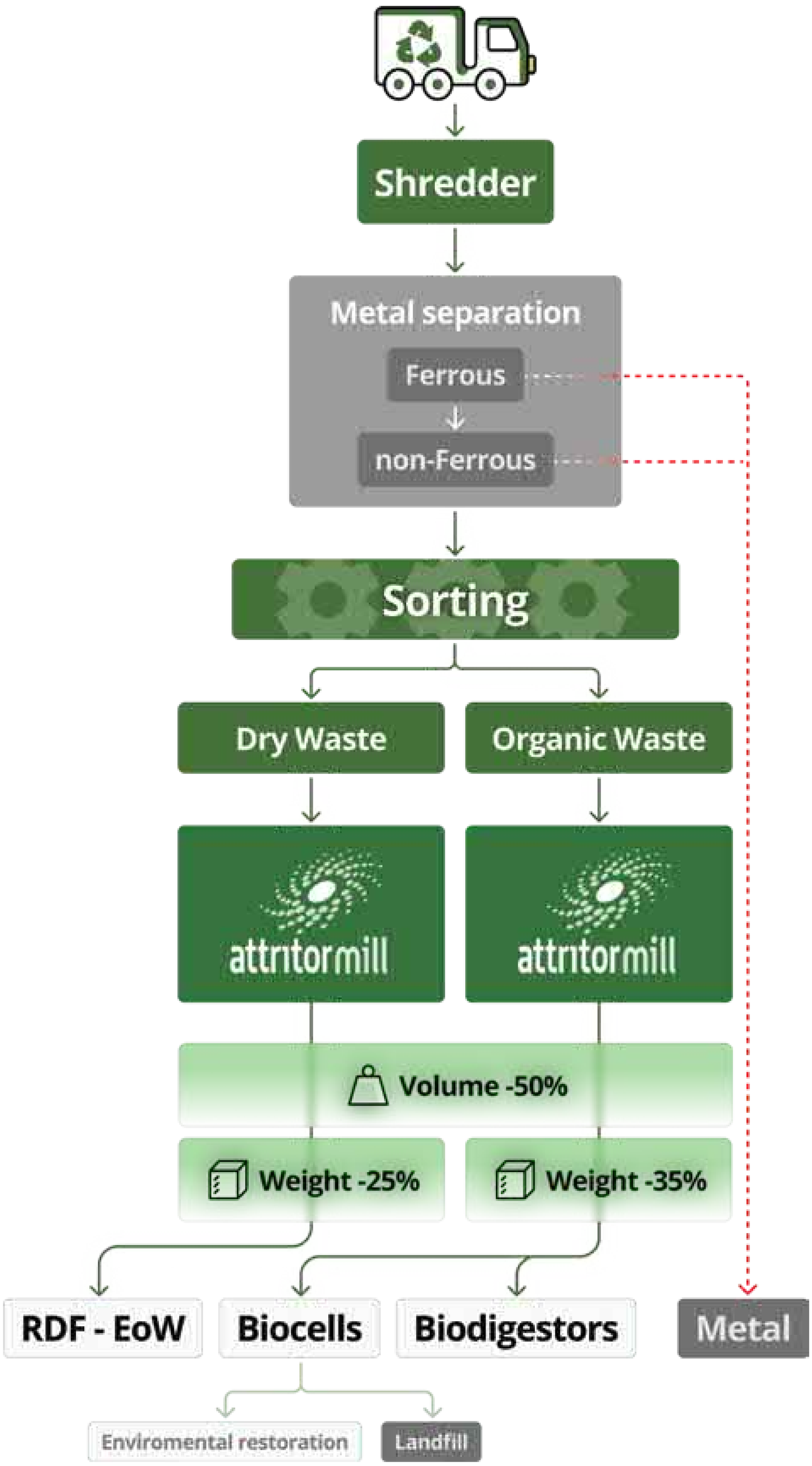
TMB Integration

UNSORTED WASTE WORKFLOW



TMB Integration

SORTED WASTE WORKFLOW



Reduction in moisture content

How it works?

Isothermal compression

The water is expelled with the steam, thus reducing the weight and volume of the treated waste.

Isochore action

Within the AttritorMill the particles are compressed and defibrated, and their internal temperature is increased by the isochore effect.

Up to

30-45%

Reduction of moisture content in saturated materials

Anti-bacterial effect

The extremely fast increase in pressure and temperature of the particles treated with AttritorMill favours the stabilisation of the waste, reducing the process time to achieve a sanitised waste.

This results from the thermal and pressure stress induced on individual bacterial colonies and, at the same time, a reduction in the amount of water and nutrients available for their proliferation.

-70%

Decreased time needed to lower and stabilise the waste's Total Viable Count

Integration of AttritorMill Mechanical-Biological Treatment plants

MBT Mechanical Biological Treatment	AttritorMill MBT + Micronizer Mill
Fermentation of waste (aerobic or anaerobic) is used to consume the organic fraction, reducing it to CO2, water, methane, ammonia and other gases and thus, reduce the bacterial load.	AttritorMill uses high impact pressure of the grinding masses to transform the organic fraction, reducing it to water-soluble fragments, thus, ***reducing the bacterial load***.
The material is preheated to temperatures above 55°C for three-four days as a "sterilization" treatment, killing only some some of the existing bacteria.	The waste is treated at high pressure (more than 1000 atmospheres of impact pressure) physically destroying cells and bacterial colonies and ***demolishing the large molecular chains of proteins*** that make up the food of bacterial strains.
The material stays in the biocells under tilting and spraying of air and water up to a reduction of viable count below 1000mg 0^2 kg $-^1$ $h-^1$; usually such value is reached between 25 and 35 days ***(600 to 840 hours)***.	The material, after the micronization treatment with AttritorMill, is stationed for 5–7 days to reach a total viable count below 1000mg 0^2 kg $-^1$ $h-^1$ ***(120 to 168 hours)***.
Average Emissions CO2 = 150 kg/t CH4 = 0.85 kg/t NH3 = 0.8 kg/t N2O= 0.1 kg/t	**Average Emissions** CO2 = 11 kg/t CH4 = 0.06 kg/t NH3 = 0.06 kg/t N2O= 0.01 kg/t

EU Guidelines

EU Directive 2018/850, provides that from 2030 the landfilling of all waste suitable for recycling or recovery, in particular municipal waste, will be prohibited.

EU Directives 2018/851 and 852 set recycling and recovery targets for municipal and packaging waste from 2025.

The preparation and pre-treatment of the over-waste fraction and the under-waste fraction below are aimed at recycling, recovery and the phasing out of landfilling.

The frame of reference of the objectives and obligations set by European directives and national regulations necessarily requires organisational and technological changes in waste management, i.e. the transition from disposal to recycling and recovery with the progressive reduction of landfilling up to a maximum of 10% of waste by 2023.

AttritorMill is the perfect solution to be integrated into waste treatment systems to achieve the targets set by EU legislation.

Benefits overview

Production of RDF (EoW)

Reduced stabilistation time

Volume reduction

Weight reduction

Homogenised output

Acceleration of anaerobic digestion of organic waste

Reduced operating energy costs (32kWh/t)

Patents

AttritorMill's waste refining micronisation process is protected by a patent granted by the **European Patent Office (EP 2846917B1)**.

(19) European Patent Office

(11) **EP 2 846 917 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

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(87) International publication number: **WO 2013/167851 (14.11.2013 Gazette 2013/46)**

(54) **ATTRITOR MILL AND PROCESS FOR USING IT**
RÜHRWERKSMÜHLE UND PROZESS FÜR BENUTZUNG DAVON
BROYEUR AGITATEUR ET PROCÉDÉ POUR SON UTILISATION

(84) Designated Contracting States: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(43) Date of publication of application: **18.03.2015 Bulletin 2015/12**

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(56) References cited:
EP-A1- 2 351 616 **EP-B1- 1 058 584**
DE-A1- 4 436 932 **DE-B3-102007 005 250**
US-A- 2 297 009 **US-A- 4 844 355**

International Patent application
PCT/IB2023/053475

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Modular machinery – 4 Milling Chambers Model

Technical Specifications

Input capacity	
Single chamber (min)	2t/h
Total system (min)	**8t/h**
Control system	PLC
Energy consumption	32kWh/t

Measures	
Length	9.400mm
Width	4.000mm
Height	5.500mm
Weight	32.000kg

data refer to a unit of 4 chambers, however AttritorMill plants are modular, equipped with several individually operable grinding chambers, which can be assembled to meet the process requirements of each Operator.

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