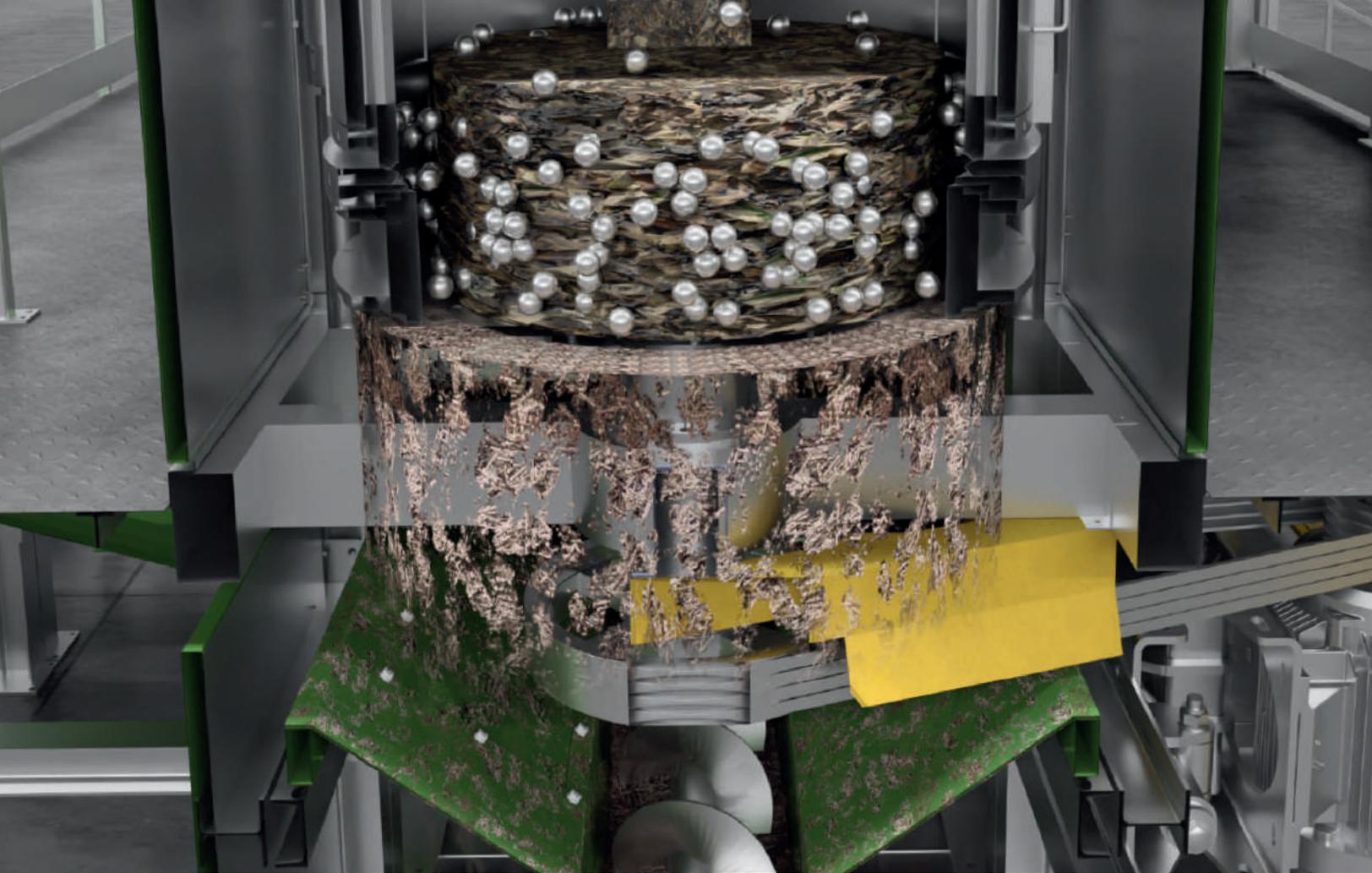


A pair of hands, one from the left and one from the right, are shown holding a small globe of the Earth. The globe is made of a textured material, possibly paper or clay, with blue for the oceans and green for the continents. The hands are positioned as if cradling the globe. The background is a light, solid green color.

**Innovative technologies
for sustainable
development**



The solution for waste treatment

AttritorMill®

AttritorMill® is a plant distinguished by its innovative and exclusive features, capable of processing waste selected through mechanical treatment. The meccano physical processes that develop within its refining chambers alter the waste's molecular structure.

The patented technology behind AttritorMill® employs various grinding mass systems and, thanks to specific thermo-pressure conditions, ensures the material's micronization and a **radical improvement in output**, all at extremely low operating costs.

The science behind the treatment



AttritorMill® is the world's first industrial-scale "mechano-physical mill" capable of continuous operation.

Until 2008, this technology remained experimental, tested only in laboratories and never implemented on an industrial scale.

AttritorMill® was developed by industry professionals in collaboration with leading public research institutes to refine the most advanced methodologies for waste treatment.

Our commitment has led to the design and production of the first industrial machines AttritorMill®, based on the principle of grinding through friction and impact.

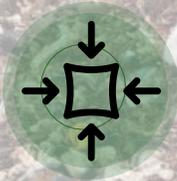
The micronization system operates through specialized grinding masses with different properties. These masses, propelled at high speed against waste particles, cause fragmentation and dehydration.

Treatment effects



Isothermal compression

Water is expelled with the vapor, thereby reducing the weight and volume of the treated waste



Isochoric effect

The particles are compressed and sheared, increasing the internal temperature due to the isochoric effect



-60%

Reduction in moisture content of saturated materials

Plant

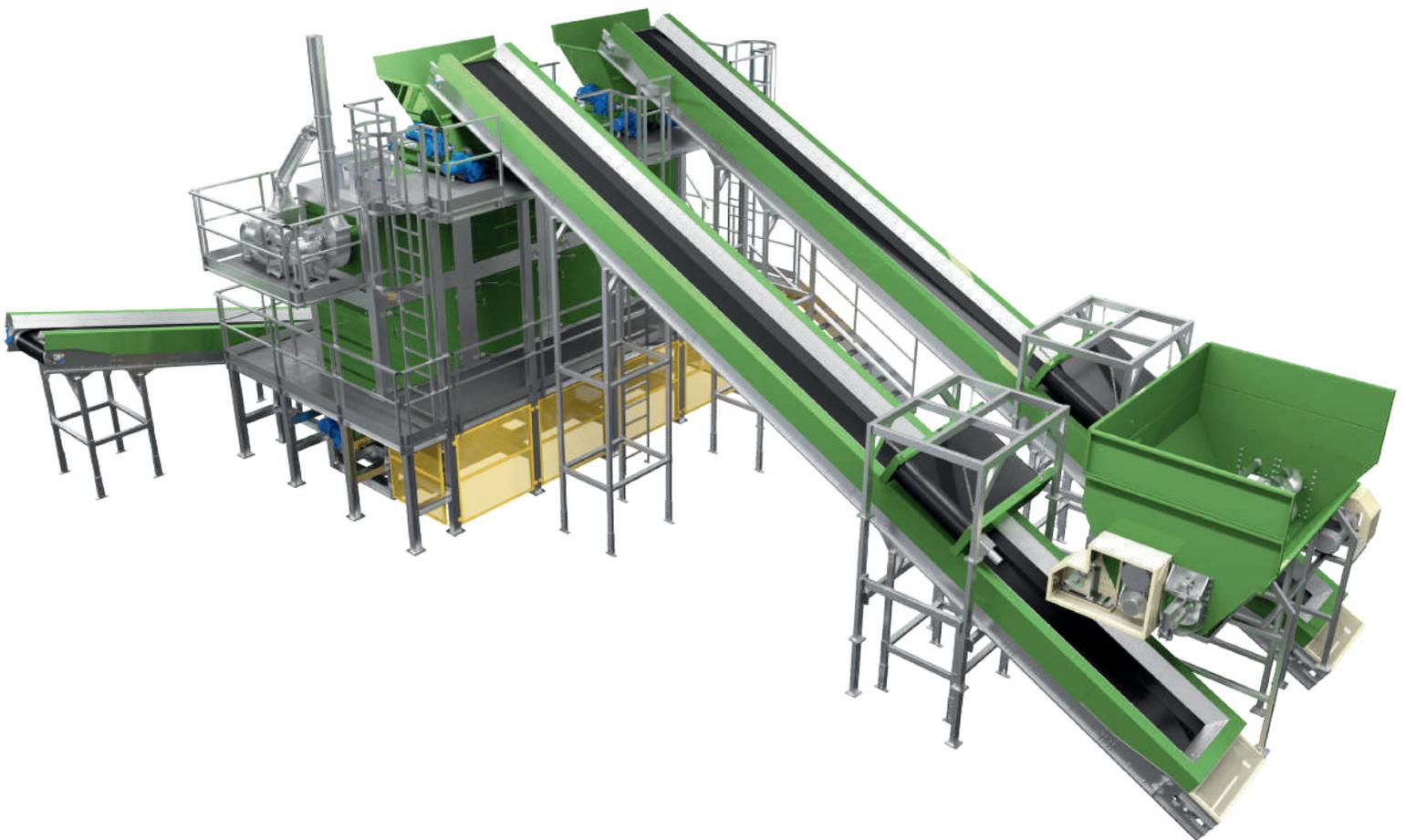
The ATTRITORMILL® system complies with the requirements specified in the «Industry 4.0 Model».

The core of the AttritorMill® is represented by the refining chambers.

It is within these chambers that the specific conditions, to which the waste is subjected, lead to numerous advantages, including size reduction, removal of the aqueous component, decrease in the time required for material stabilization and reduction of odorous emissions.

The AttritorMill® system is equipped with the following components:

- Feeding Hopper
- Loading conveyor belts
- Ferrous separator
- Dosing Hoppers
- Extraction Hoppers
- Discharge conveyor belt
- Auxiliary structures for inspection and maintenance
- Vapor extraction system





attritormill®

Machinery - 4 Chambers Model

Technical Specifications

Input capacity	
Single chamber	3-4 m³/h
Total system	12-16 m³/h
Control system	PLC
Energy consumption	36-38 kWh/m³

The stated production data are calculated using a reference of 1m³ = 0.6 tonnes

Measures	
Length	9400 mm
Width	4000 mm
Height	5500 mm
Weight	42000 kg

The data refers to a unit with 4 chambers, but the system is modular in structure and operation.

Assistance

Full service support for the entire range

The Full-Service support is designed to assist clients throughout the entire lifecycle of the plant, from design and installation to daily operations. This service includes technical assistance for operational issues, staff training, optimization of plant use, and both routine and emergency maintenance.

After-sales support is essential for maintaining high performance and extending the plant's operational lifespan. In fact, the timely and scheduled maintenance service helps prevent issues that could affect the plant's efficiency, enhancing its overall reliability and minimizing downtime.



Unsorted Waste

The AttritorMill® is capable of efficiently handling the **single stream of unsorted waste**, processing it into two separate fractions through dedicated preliminary separation systems.

Indeed, this approach maximizes the recovery of materials intended for recycling while **reducing losses typical of traditional processes**.

Additionally, by eliminating the dependence on the quality of separate collection, the system ensures a more uniform and reliable operation, even in contexts where upstream separation is not optimal, contributing to cost reduction and improving overall economic efficiency.

Finally, the treatment allows more effective energy recovery, maximizing the valorization of fractions.



Energy Recovery

Optimized management of the remaining fractions, transforming them into energy resources.



Simplify Operation

Eliminates dependence on the quality of separate collection, making the process more uniform and less prone to inefficiencies.



Costs Reduction

With a single stream, the treatment phases are simplified, reducing operational costs and increasing economic efficiency.



Optimized Recovery

Allows for the maximization of useful material recovery, designated for recycling and reuse, while preventing losses due to incomplete separation processes.



Over-sieve fraction



Waste Valorization

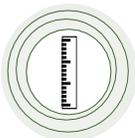
The waste becomes an alternative energy resource, contributing to the production of clean and sustainable energy.



SRF Production

End of Waste Fuel
compliant with

UNI EN ISO 21640:2021



Output Dimension

The outgoing materials have sizes ranging from 2 to 15 mm.



Reduces the operating costs

Improves resource management and reduces disposal-related costs.

The dry waste output from the AttritorMill®, after being processed, is classified as **SRF** according to the **UNI EN ISO 21640:2021 standard**, with a size ranging from 2 to 15 mm.

The obtained SRF represents an **alternative energy source** and can be used into specific **energy production facilities**.

By representing a resource, the SRF ceases to be regarded as waste and acquires "**End Of Waste (EoW) status**".

This achievement is made possible through rigorous processes of selection, transformation, and quality verification, ensuring that the SRF meets the highest environmental standards.

The SRF can be used as fuel in cement plants, thermal power stations, and steel mills, contributing to the production of clean and sustainable energy.

This innovative approach aids in reducing waste destined for landfills and promotes the transition toward a circular economy.



Under-sieve fraction

In the treatment of the oversize fraction and organic waste from separate collection, the AttritorMill® can be configured with different processing solutions to achieve the desired output.

The thermo-pressure conditions induced on the particles of the waste treated with the AttritorMill® promote the stabilization of the waste, reducing processing times to obtain stable material, that can be used for anaerobic digestion and the production of technosol.

In current TMB plants, AttritorMill® reduces biostabilization times. In fact, the stress induced on the bacterial colonies that populate the material and, at the same time, the reduction in the amount of water and nutrients available for their proliferation leads to a **drastic reduction in biostabilization times**.

Additionally, the micronization process of the AttritorMill® **increases the surface area of the waste** and activates the mesophilic phase (37-40°C), facilitating and accelerating the release of methane gases and the **biodigestion process**.

Moreover, the AttritorMill®, when used for the treatment of solid waste from biodigesters, **reduces odor emissions and moisture content, enabling the waste to be processed in energy recovery facilities**.



Accelerates Biostabilization

The combination of thermo-pressure stress, reduced moisture content, and nutrient availability, decreases the bacterial load.



Accelerates Biodigestion

The increase in specific surface area of the waste accelerates biodigestion.



Reduces Emissions

The treatment reduces odor emissions.



Waste Valorization

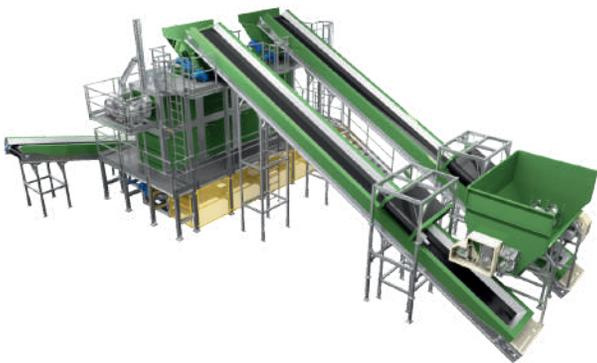
Optimizes the processing residue for transfer to energy recovery facilities.

The Attritor Mill range

The Attritor Mills represent a technological excellence and are designed to ensure high performance and optimal efficiency in industrial refining processes.

These systems, integrating innovative and sustainable technologies, offer advanced solutions for waste treatment, resource recovery, and minimizing environmental and energy impact.

Available in various configurations, specifically designed for their intended applications, Attritor Mills can be customized to meet the specific requirements of each client, making them suitable for a broad spectrum of industrial applications.

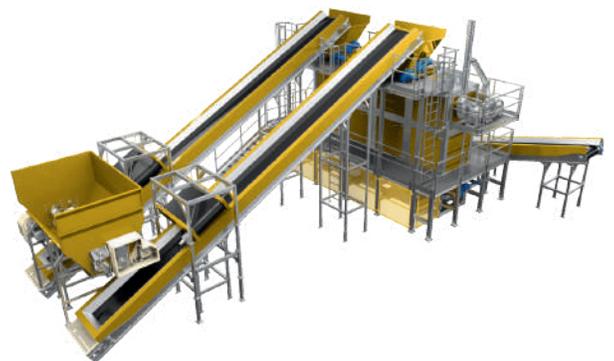


Attritor Mill Biodigester Pro

Particularly suitable for the treatment of waste with high moisture content, rich in organic fraction and mixed plastic polymers. Attritor Mill Biodigester Pro is used for the production of Solid Recovered Fuel (SRF).

Attritor Mill Organic Pro

Specifically designed for the treatment of high-moisture waste, rich in organic fraction and mixed polymers. It enhances the availability of the organic fraction, making it particularly suitable for feeding into anaerobic biodigesters or for use as a component in the production of technosol.



Attritor Mill Css-C Pro

Advanced technology designed for the production of Solid Refuse Fuel (SRF) from unsorted or residual waste. Attritor Mill Css Pro produce a homogeneous SRF-EoW (End of Waste) with very low moisture content.



Advantages

Attritor Mill Organic Pro in MBT Plant



Mechanical Biological Treatment (MBT)

In the MBT process, waste undergoes fermentation (either aerobic or anaerobic) to break down the organic fraction, converting it into CO₂, water, methane, ammonia, and other gases, thereby reducing the bacterial load.

During the mechanical-biological treatment, the waste is preheated to temperatures exceeding 55°C for a period of three days as part of a “sterilization” treatment, effectively killing a portion of the bacteria present.

The waste remains in the biocells, where it is subjected to stirring and irrigation with air and water, until the PDRI is reduced to below 1000 mgO₂kg_{sv}⁻¹h⁻¹; This level is typically achieved after a **minimum of 25 days (600 hours)**.



Average emissions

CO₂ = 150 kg/t
CH₄ = 0.85 kg/t
NH₃ = 0.8 kg/t
N₂O = 0.1 kg/t



25 days for biostabilization

Attritor Mill Organic Pro Micronizer + TMB

Installed upstream of a traditional MBT plant, the **Attritor Mill Organic Pro**, due to its unique features, **accelerates the biological stabilization process and reduces PDRI levels**. In the treatment with the Attritor Mill Organic Pro, the use of attritors and grinding media initiates processes that lead to a significant reduction in weight, volume, and water content—an essential factor for bacterial colony proliferation.

The treated waste is then transferred to the MBT biocells, where its increased compaction and reduced moisture content lead to fewer loading operations. Additionally, the lower bacterial load accelerates the biological stabilization process.

With this layout, the reduction of PDRI below 1000mg O₂ kg⁻¹ h⁻¹, is typically achieved **dafter only 5 days (120 hours)**.

This results in overall optimization of energy consumption for the treatment plant and a significant reduction in operational costs.



Accelerates biostabilization



Reduces the weight by up to 30%



Average emissions

CO₂ = 11 kg/t
CH₄ = 0.06 kg/t
NH₃ = 0.06 kg/t
N₂O = 0.01 kg/t



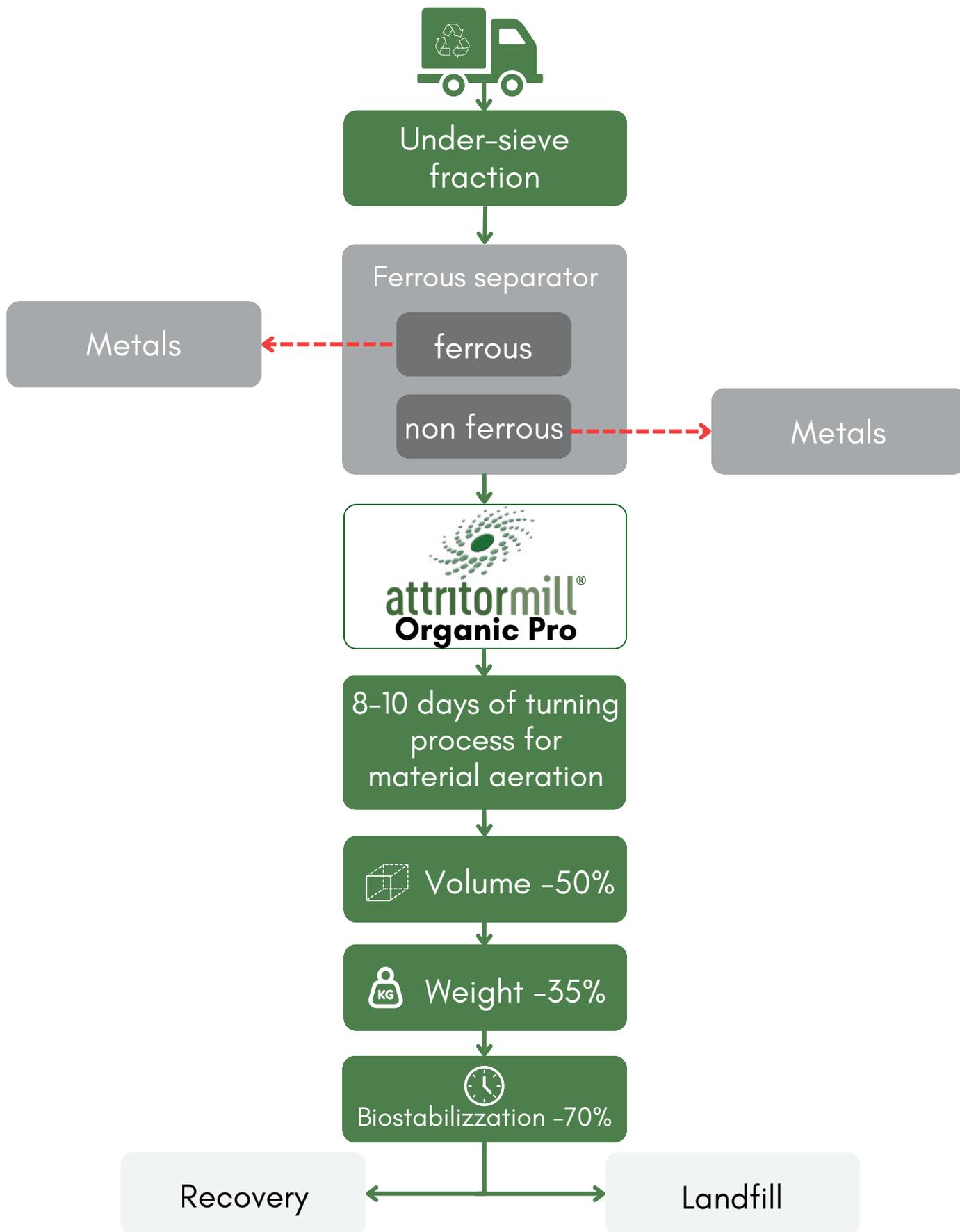
Reduces the volume by up to 50%



Reduces the operating costs

Attritor Mill in the MBT Plant

SEPARATED STREAM LAYOUT



Advantages

Attritor Mill Biodigester Pro with Biodigester



Biodigester

The biodigester uses anaerobic digestion of waste to degrade the organic fraction, transforming it into biogas (methane and carbon dioxide) and digestate, thus reducing the bacterial load.

Inside the biodigester, waste is pretreated and heated to temperatures between 35°C and 55°C for several days, promoting the activity of methanogenic bacteria and initiating the digestion process.

In the biodigester, the waste is maintained in an oxygen-free environment for a period of **25 to 30 days**, until the complete degradation of the organic fraction and the stabilization of the digestate.

Attritor Mill Biodigester Pro Micronizer + Biodigestore

Designed for the treatment of high-moisture waste rich in organic fractions and mixed polymers, the **Attritor Mill Biodigester Pro** can be integrated for the valorization of plastic fraction resulting from the pression process.

Infact, the plastic fraction derived from the compression process is sent to the refining chambers of the Attritor Mill Biodigester Pro, where the mechanical and physical actions lead to the immediate expulsion of liquids and gases and in the size reduction of materials. This results in a substantial reduction in moisture and, consequently, weight.

The waste that has been processed in this manner is converted into **Solid Recovered Fuel (SRF)**.

Additionally, the concentrate resulting from pressing process can be sent to the **biodigester**.



**SRF
Production**



**Reduce the weight
by up to 55%**



**Reduce the volume
by up to 60%**

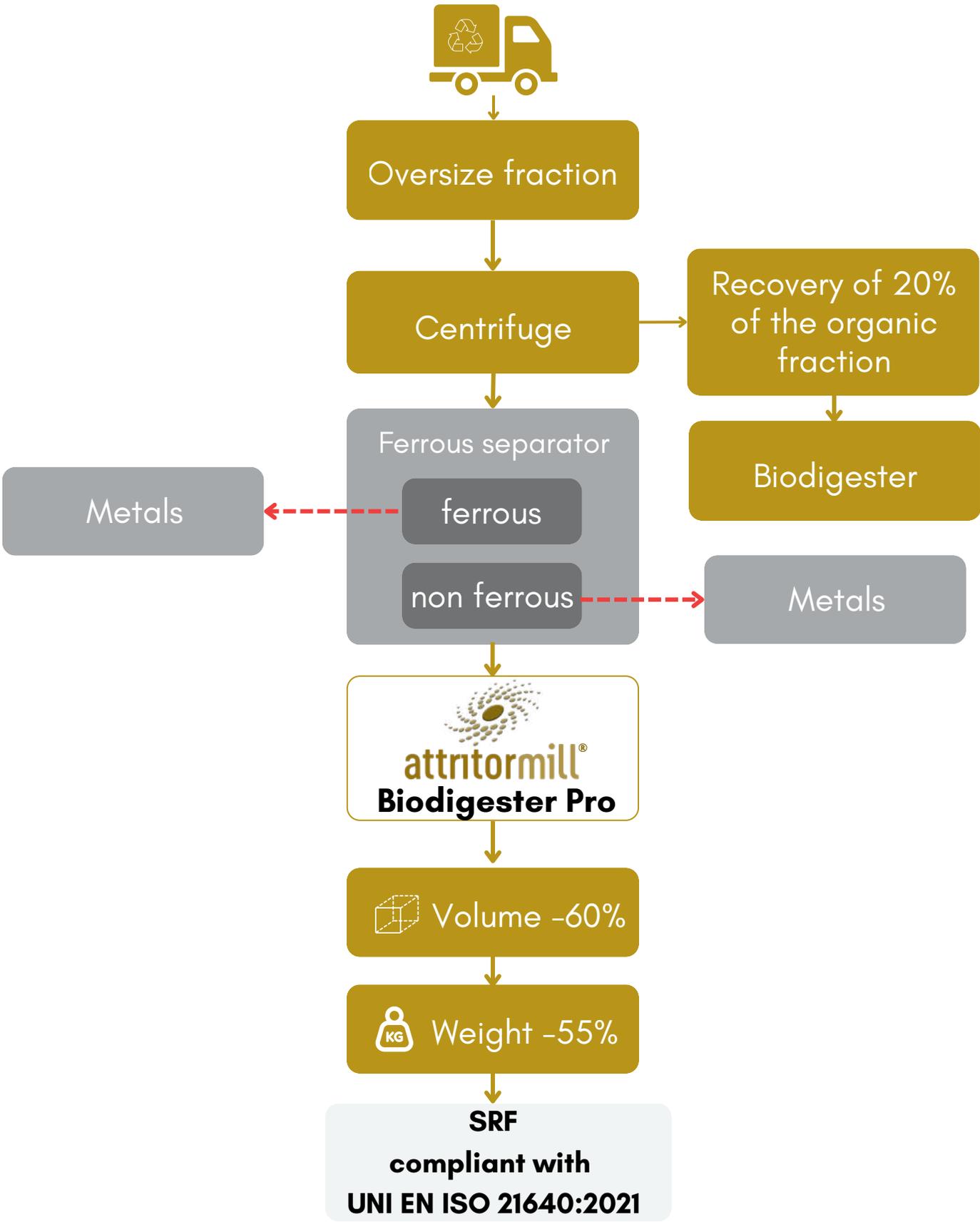


**Reduces the
operating costs**



**Energy consumption
38 kWh/m³**

Attritor Mill in the Biodigesters Plant



Advantages

Attritor Mill CSS Pro



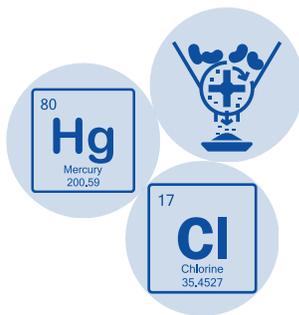
Attritor Mill CSS-C Pro

Attritor Mill CSS Pro is an innovative machine designed for the **production** of Solid Recovered Fuel (**SRF-EoW**) from mixed municipal waste or residual fractions, obtained from the mechanical sorting of unsorted waste.

During processing, the friction forces generated within the refine chamber induce dewatering and cracking effect in the waste, resulting **in the physical breakdown of waste particles and a substantial reduction in moisture content.**

The micronization process performed by Attritor Mill CSS Pro minimizes variations in waste composition while simultaneously drying the material, increasing its calorific value and volumetric energy density.

As a result, the system produces an optimized SRF with enhanced homogeneity and a lower moisture content, ensuring superior fuel quality.



Caratteristiche di classificazione							
Caratteristica	Misura statistica	Unità di misura	Valori limite				
			1	2	3	4	5
PCI	media	MJ/kg t.q.	≥ 25	≥ 20	≥ 15	≥ 10	≥ 3
Cl	media	% s.s.	≤ 0,2	≤ 0,6	≤ 1,0	≤ 1,5	≤ 3,0
Hg	mediana	Mg/MJ t.q.	≤ 0,02	≤ 0,03	≤ 0,08	≤ 0,15	≤ 0,50
	80°percentile	Mg/MJ t.q.	≤ 0,04	≤ 0,06	≤ 0,16	≤ 0,30	≤ 1,00

Classificazione dei combustibili solidi secondari (CSS) presente in D.M. 22/13

(I valori in giallo sono quelli afferenti ai CSS Combustibili-prodotto)



**SRF
Production**



**Reduce the weight
by up to 35%**



Energy consumption
38 kWh/m³



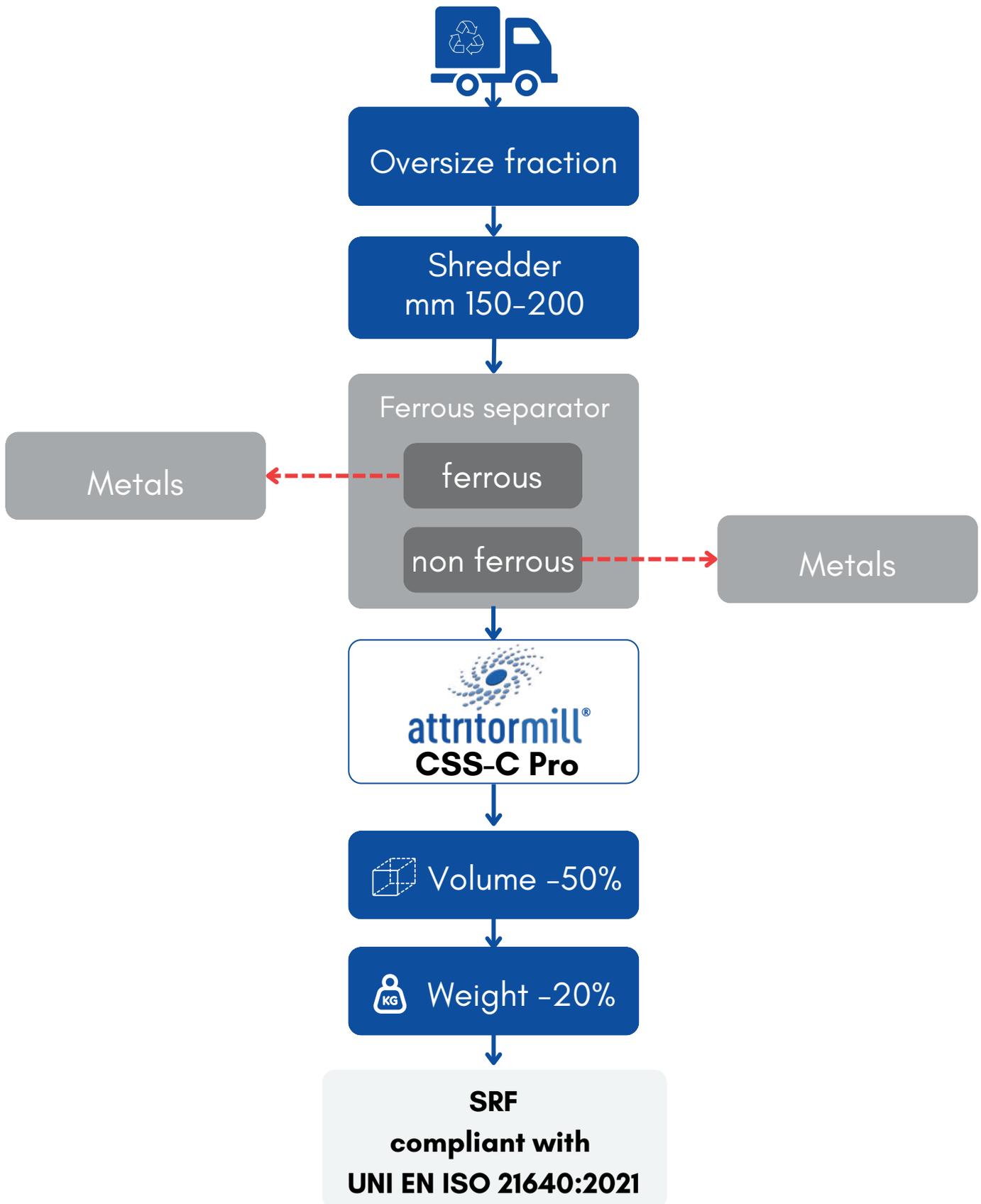
**Reduce the volume
by up to 50%**



**Reduces the
operating costs**

Attritor Mill

SEPARATED STREAM LAYOUT



Redefining the future of unsorted Waste Treatment



Urban waste management is undergoing a profound transformation. EU directives set clear and stringent targets: by 2030 it will no longer be permitted to landfill waste suitable for recycling or recovery, and by 2035 landfilling will be limited to a maximum of 10% of the total waste generated. This challenge compels Member States to accelerate recycling, energy recovery, and waste reduction, while promoting material recovery and minimizing environmental impacts.

The treatment line for unsorted waste is based on an integrated approach that reduces impurities, weight, and volume of the material. Furthermore, the proposed system allows the recovery of recyclable fractions and the valorization of both the dry component—suitable for the production of high-quality fuel—and the organic component, made fit for anaerobic digestion or for the generation of technosol. The result is an efficient system that combines material recovery, energy production, and environmental sustainability.

The line employs the Attritor Mill range in combination:

Attritor Mill CSS-C Pro, used to process the oversize fraction to obtain a high-quality Solid Recovered Fuel (SRF compliant with uni en 21640:2021);

The undersize fraction, rich in organic matter, is instead treated with the

Attritor Mill Organic Pro, transforming it into a clean and biologically active organic fraction, ready for anaerobic digestion or for the production of technosol.

The result is an efficient system that integrates material recovery, energy production, and environmental sustainability.



Attritor Mill Organic Pro



Attritor Mill CSS-C Pro

The Next Generation of MBT Plants



ATTRITORTRADE has established a dedicated design department to support clients in upgrading their plants in compliance with Legislative Decree 121, providing technical assistance and tailor-made solutions.

The revamping of MBT plants includes targeted interventions in the field of waste separation, with the aim of:

- increasing the overall efficiency of the treatment line,
- reducing or eliminating the use of biocells,
- recovering materials intended for reuse,
- minimizing the amount of waste sent to landfill, in full compliance with current regulations.

The proposed line represents a virtuous model of integrated waste management:

- the oversize fraction produces a high-quality Solid Recovered Fuel (SRF);
- the undersize fraction yields a matrix suitable for subsequent valorization processes such as anaerobic digestion, composting, or technosol production.

The result is an innovative solution that maximizes the recovery of waste fractions, reduces environmental impact, and contributes to the transition toward a circular economy.



**Maximized
Resource Recovery**



**SRF
Production**



**Organic material
suitable for
anaerobic digestion**



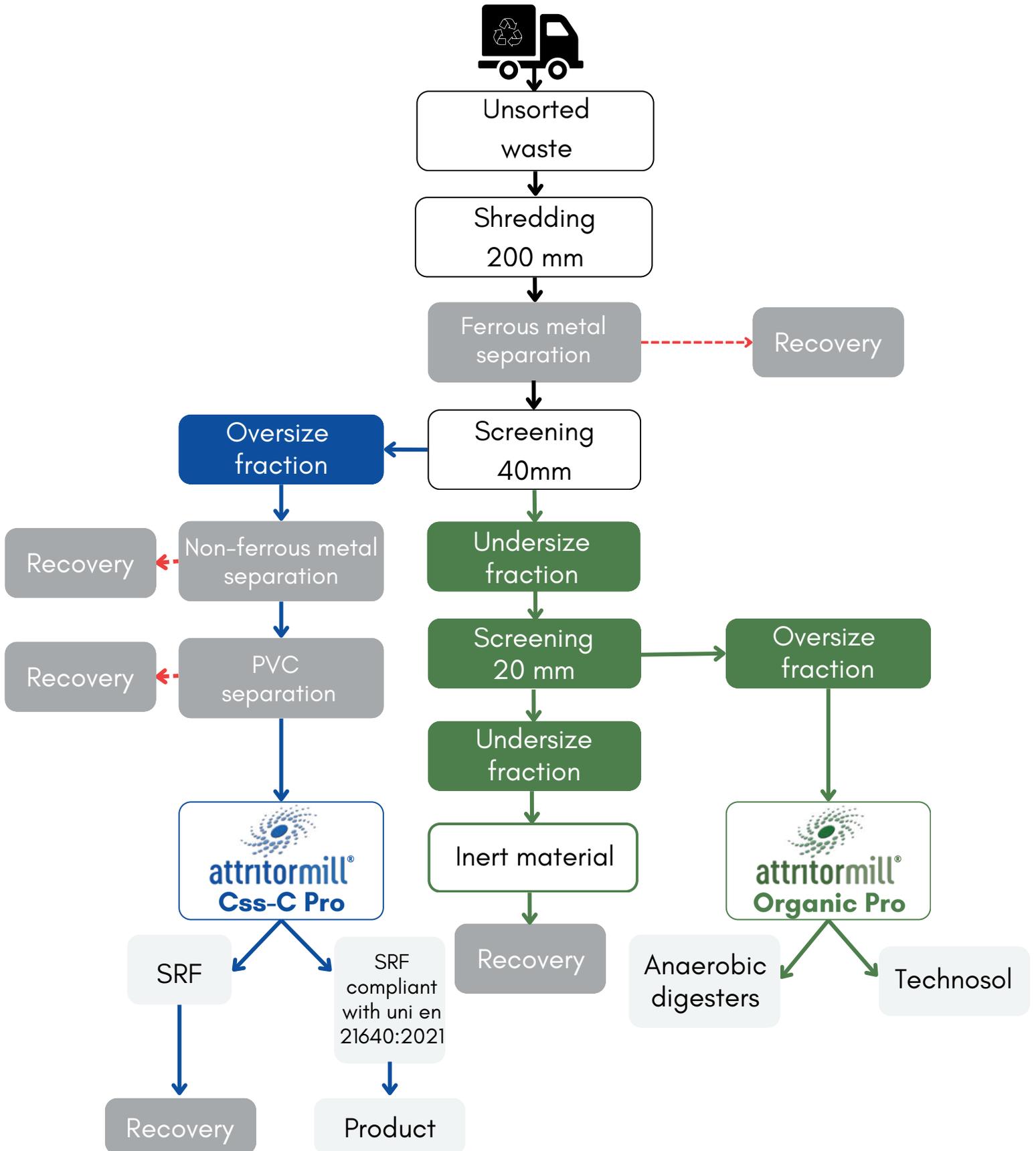
**Technosol
Production**



**Compliant with
D.lgs. 121**

Attritor Mill in the MBT Plant

SINGLE STREAM LAYOUT



The Patents

The micronization system for waste refinement of AttritorMill® is protected by a patent granted by the European Patent Office (EP 2846917B1).

(19) 	
	(11) EP 2 846 917 B1
(12) EUROPEAN PATENT SPECIFICATION	
(45) Date of publication and mention of the grant of the patent: 18.09.2019 Bulletin 2019/38	(51) Int Cl.: <i>B02C 17/16 (2006.01)</i>
(21) Application number: 12721577.0	(86) International application number: PCT/GB2012/051024
(22) Date of filing: 10.05.2012	(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	(74) Representative: Bonatto, Marco et al Barzanò & Zanardo Milano S.p.A. Via Borgonuovo, 10 20121 Milano (IT)
(43) Date of publication of application: 18.03.2015 Bulletin 2015/12	(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
(73) Proprietor: Belmonte Investments Limited Preston, Lancashire PR2 2YP (GB)	
(72) Inventor: FENECH, Eric Pace Malta (MT)	

International patent filing PCT/IB2023/053475

The Patents

The micronization system for waste refinement of AttritorMill® is protected by a patent granted by the European Patent Office (EP 4427843A1).

(19)		
		(11) EP 4 427 843 A1
(12)	EUROPEAN PATENT APPLICATION	
(43) Date of publication: 11.09.2024 Bulletin 2024/37		(51) International Patent Classification (IPC): <i>B02C 18/12</i> ^(2006.01) <i>B02C 18/16</i> ^(2006.01) <i>B02C 18/18</i> ^(2006.01) <i>B02C 18/22</i> ^(2006.01) <i>B02C 18/24</i> ^(2006.01) <i>B02C 25/00</i> ^(2006.01)
(21) Application number: 24162437.8		(52) Cooperative Patent Classification (CPC): B02C 18/12; B02C 18/18; B02C 18/2258; B02C 18/24; B02C 25/00; B02C 2018/162
(22) Date of filing: 08.03.2024		
(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 ME MK MT NL NO PL PT RO RS SE SI SK SM TR Designated Extension States: BA Designated Validation States: GE KH MA MD TN	(72) Inventors: • REALE, Luigi 95126 Catania (CT) (IT) • REALE, Marcello 62024 Matelica (MC) (IT)	(74) Representative: Bonatto, Marco et al Barzanò & Zanardo Milano S.p.A. Via Borgonuovo, 10 20121 Milano (IT)
(30) Priority: 10.03.2023 IT 202300004485		
(71) Applicant: ATTRITOR MILL Limited Sliema (MT)		
(54) GRINDING DEVICE AND PROCESS FOR USING IT		
(57) The grinding device (1, 1') according to the invention comprises a grinding container (5) which forms inside it a grinding chamber (7), and a rotor (9) which forms a plurality of processing arms (11). The rotor (9) and the arms (11) rotating on themselves, grind, chop, shred or micronise the material to be processed contained in the grinding chamber (7). The device (1, 1') also	comprises A) a feeding system (13) that feeds the material to be processed into the grinding chamber (7); B) a control system configured for controlling the feeder (13) based on B1) the resistant torque opposing the rotation of the rotor (9) in the grinding chamber (7); and/or B2) based on the speed of rotation of the rotor (9); and/or B3) based on the power required to drive the rotor (9).	

International patent filing PCT/IB2023/053475



Attritor Mill Commercial Network Manager

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