

MAGMA Smelting Unit for High-Temperature Recycling of unsorted Municipal waste

Introduction –

Mankind has accumulated and dumped on the Earth an enormous amount of industrial and household waste generated by human activities.

Waste has been and continues to be disposed of in dumps, storage sites, deposits and special landfills that cover vast areas.

Waste exerts an adverse effect on the environment and people themselves. Intensive economic development and the concept of “a consumer society” speed up the accumulation of such waste in the 21st century.

At the same time, there is a continuing increase in the extraction of resources necessary for accelerated economic growth and for meeting the demands of “the consumer society”: ores, energy carriers and mineral components required for growing production.

As a consequence, the surface of our planet continues to be covered with new metallurgical waste dumps, slag heaps, tailing ponds, abandoned pits, etc.

The problem of efficient processing of most of the above-mentioned waste is solved with the help of MAGMA, which is a cost-effective continuous skull smelting unit that can process and convert waste into useful products (metals, construction materials, thermal power and electricity) by waste-free and environmentally clean technologies.

Waste-free processing of Municipal waste in MAGMA –

The multi-purpose smelting unit MAGMA provides autogenous process of high-temperature recycling of unsorted municipal waste on a layer of molten over-heated slag that forms from mineral components of waste & fluxes that are specially added in the process of recycling.

MAGMA Smelter uses liquid sodium as coolant, which is proven in Nuclear Reactors & Nuclear Submarines in the last 30 years. As compared to water, Liquid sodium is 90 times more efficient.

In MAGMA, temperature of the working space of the smelting chamber over the layer of molten slag is 1,800-1,900^oC & the temperature of slag is 1,400-1,650^oC. Under such conditions, the smelting chamber produces a ‘thermal shock’, under which the fed waste immediately heats up to high temperatures that rule out the possibility of the formation of dioxins.

In MAGMA, gases stay at 1,850^oC for 3 seconds. Under such conditions, almost 100% destruction of dioxins & furans is ensured. These toxic elements are carcinogenic even at nanogram levels and can reach the human body through ground water & air. None of the existing technologies can destroy them completely.

Recycling of waste in oxygen allows to decrease the volume of off-gases & reach concentrations of NO_x<80mg/m³ & CO<7 mg/m³. MAGMA is equipped with highly efficient cooling system of the unit body, after-burning of CO & recovery of heat from process gases in the heat-recovery power boiler.

Off-gases are treated by a multi-stage processing route in MAGMA -

- 1) “Quenching” of gases for exclusion of secondary formation of dioxins and furans;
- 2) Cleaning of gases from hazardous substances.

The waste feeding system, as well as the smelting unit, is hermetically sealed, which creates a small under-pressure in the working space of the smelting chamber. This rules out the possibility of non-organized emissions of process gases from MAGMA to the environment.

The metal component of waste, when molten & accumulated at the bottom zone of the smelting chamber, as well as excessive amount of slag, is released from the unit non-continuously for subsequent processing into finished products. Chemical composition of the molten slag is adjusted by adding fluxes for the purpose of further production of cast-slag saleable products, which do not contain toxic components.

Main physical & mechanical properties of cast-slag crushed stones –

Properties	Cast-slag crushed stones	Granite crushed stones
Density, kg/m ³	2800-3000	2500
Strength limit, Mpa compression bending	200-500	100-300
Abrasivity, kg/m ²	0.5-0.7	1-5
Water absorption, %	0.1-0.2	0.1-1
Frost resistance, cycles	over 300	300

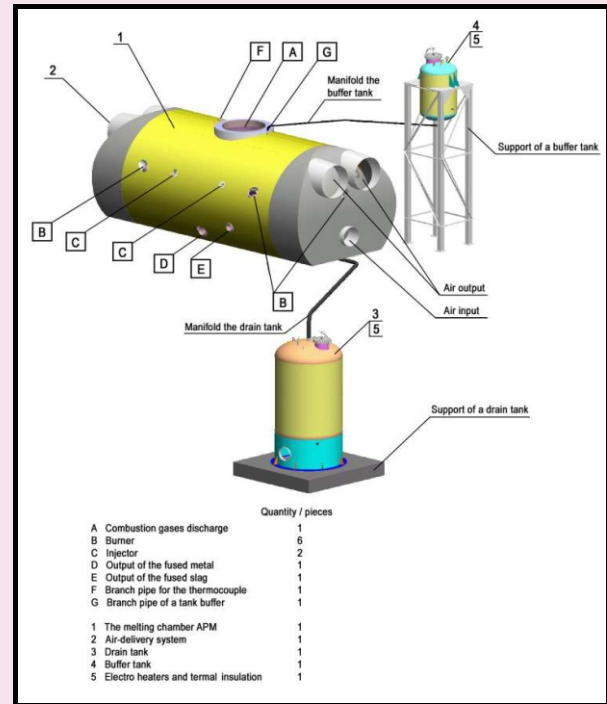
The dust captured in gas treatment facilities is injected back to the molten slag, where it is assimilated by slag.

Comparative performance of waste incineration plants –

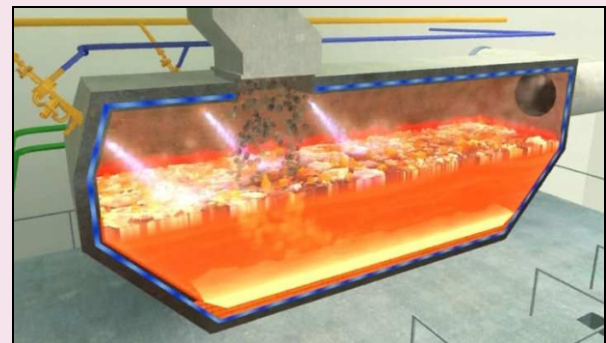
Parameter	MAGMA plant (Russia)	MVA Weisweiler GmbH (Germany)
Maximum production capacity for wet, unsorted municipal waste (metric tons per year)	330,000 (1 module 330,000 tpy)	360,000 (3 processing lines of 120,000 tpy)
Waste recycling method	incineration on surface of molten slag in oxygen	incineration on burning grate of power boiler in air
Waste from recycling process	no waste	toxic ash, toxic dust of gas treatment
Heat recovery	heat-recovery power boiler	heat-recovery power boiler
Temperature of molten slag, °C	1400-1650	—
Temperature of gas phase, °C	1800-1900	1100
Construction period, years	2	4

MAGMA can also be used for re-mediation of existing municipal landfills.

Schematic view of the MAGMA unit



Schematic view of the inside working of MAGMA unit



Production figures of high-temperature recycling of municipal waste in the MAGMA unit –

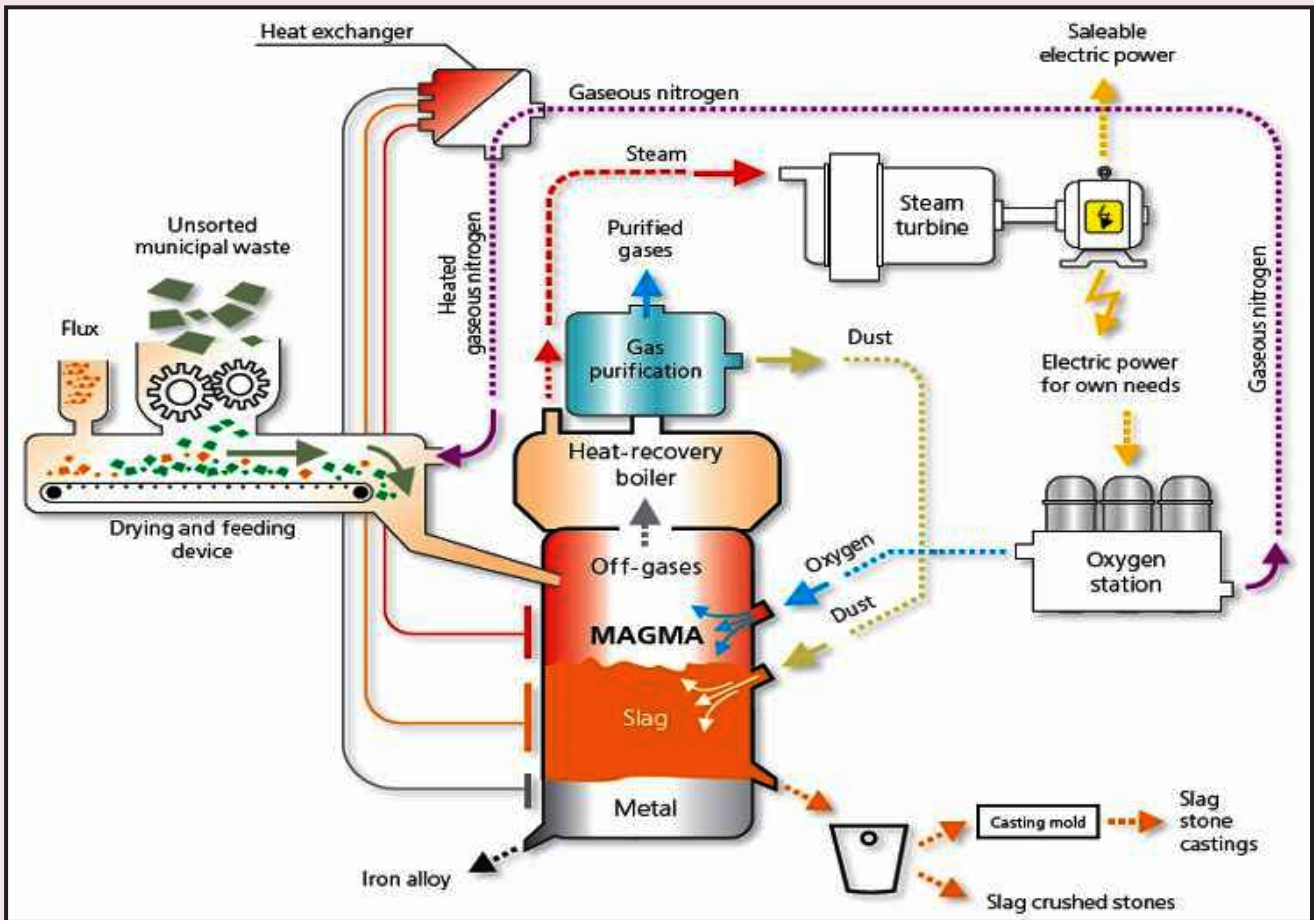
Output products	Unit per ton of wet waste	Amount
Electric power	MWh/ton	0.40-0.50
Iron alloy	kg/ton	5-30
Slag-cast products / construction materials	kg/ton	250-300

Production figures given per ton of Indian municipal waste with initial moisture content of 20% and can change depending on morphological composition of municipal waste.

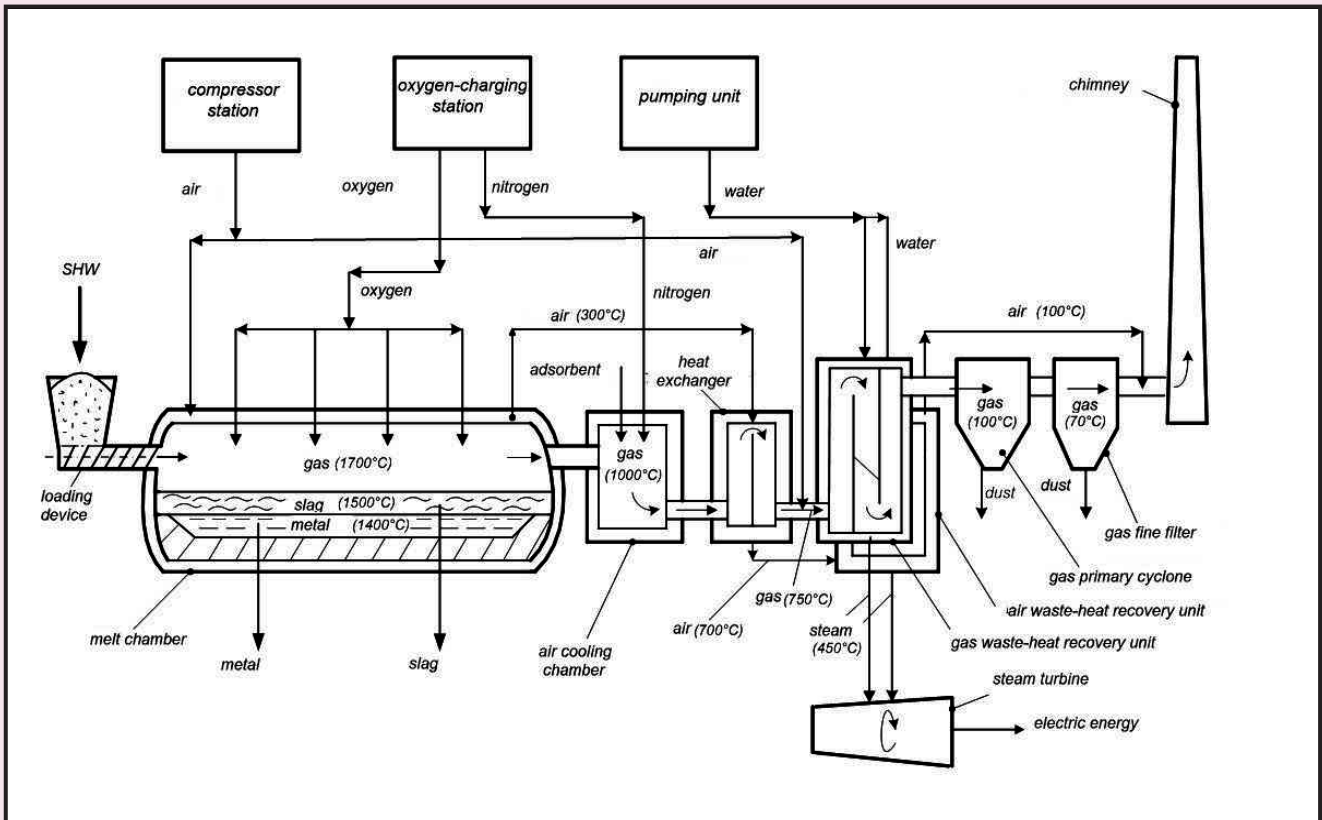
Recycling of unsorted municipal waste by MAGMA gives the following benefits –

- 1) Environmentally clean process in accordance with European Union requirements.
- 2) Profitable production ; &
- 3) Waste –free technology.

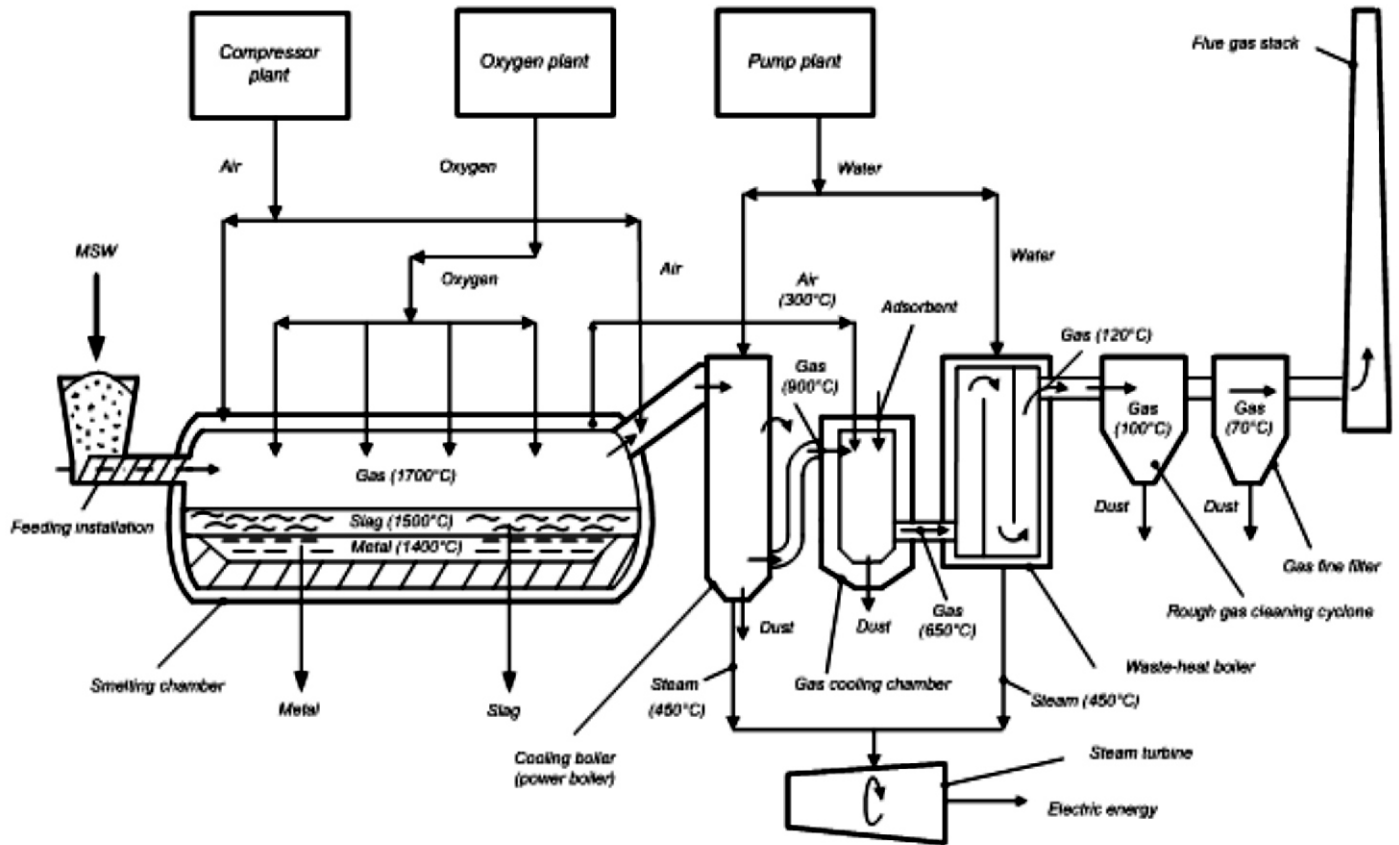
Flow Chart of MAGMA unit for high-temperature municipal waste recycling



Flow diagram for MSW processing, using MAGMA unit (option 1)



Flow diagram for MSW processing, using MAGMA unit (option 2)



MAGMA is available in 3 capacities, as under -

MAGMA Size	Average processing capacity of municipal waste per year (tons)	Power generation potential (MWh)	Recovery of Iron alloy per year (tons)	Production of Slag cast products per year (tons)	Estimated Investment (Rs. in crores)
Large	330,000	16-21	1,650-9,900	82,500-99,000	250-300
Medium	165,000	8-10	825-4,950	41,250-49,500	150-180
Small	70,000	3.5-4.5	350-2,100	17,500-21,000	75-90

Investment on the MAGMA project can be recovered in 5-7 years, depending on the plant capacity.

MAGMA can meet the objectives of 21st century, as a clean & efficient municipal waste processing technology. GoodRich is authorized to promote MAGMA technology & its wide range of applications in India.

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