TORBED* Process Reactor Technology
Application Description

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VERMICULITE EXFOLIATION – 1000mm diameter

General Introduction - The patented TORBED technology involves suspending a gently rotating bed of free flowing particles above a ring of static vanes through which high velocity hot air is directed.

The TORBED Reactor is an excellent gas solids contacting device, which suspends solid particles in a rapidly moving gas flow environment. This provides intense mixing and extremely rapid heat and mass transfer within the reactor with each individual particle being uniformly heated. The key to high rates of heat and/or mass transfer between gases and solids is the disruption of the microscopic boundary layer of gas that surrounds the solid particle. To achieve disruption, the solid must be impacted by gases at high velocity to strip away the insulating boundary layer. The TORBED® Reactor reactor types achieve this by using higher velocities of gas impact than have hitherto been achieved. The energy efficient heating system is unique to the TORBED and provides "flame free" process conditions.

The equipment is extremely compact in size compared to conventional processing equipment, quiet in operation and due to the interior of the Reactor working under a negative pressure, a clean working environment with the absolute minimum of spillage is obtained.

The TORBED Reactor, burner system, process air and control systems are skid mounted for ease of transportation and installation. The TORBED and ancillary equipment will automatically operate for extended periods with the minimum of operator attendance.

Figure 1: TORBED T1000 Module being installed

The TORBED 1000 Vermiculite Exfoliator - The TORBED 1000 is configured for continuous exfoliation of various grades of screened, crude vermiculite ores of up to 2 metric tonnes per hour. The raw material is continuously fed into the Reactor via a top loading feed system. The raw material is subjected to a rapid heat transfer within the Reactor with combustion gases, from either a gas or oil fired burner system, with typical process temperatures between 850ºC to 1200ºC (1560°F – 2200°F). The exfoliated vermiculite and exhaust gases are carried out of the Reactor for separation and further product handling as required.

The raw material feed rate is automatically controlled. This unique control system will maintain a uniform quality of exfoliated vermiculite taking into account the fluctuating moisture content and particle plate thickness of the raw material.

The interior of the Reactor is manufactured from refractory and ceramic components that are suitable for a maximum operating temperature of 1400°C (2550°F). **The interior of the Reactor can be configured to provide for lower throughput capacities thus allowing for the equipment to be easily upgraded for future requirements.**

The fully automatic control system uses an integral industrial programmable logic computer (PLC) and control panel, complete with a comprehensive fault diagnostic and recipe systems. The control and monitoring of all other ancillary equipment can be controlled via the TORBED 1000 PLC system.

In the event that the exfoliated vermiculite is to be immediately bagged, a dedicated Cooler Unit can be supplied to cool the product to approximately 35°C dependent upon the ambient air temperature.

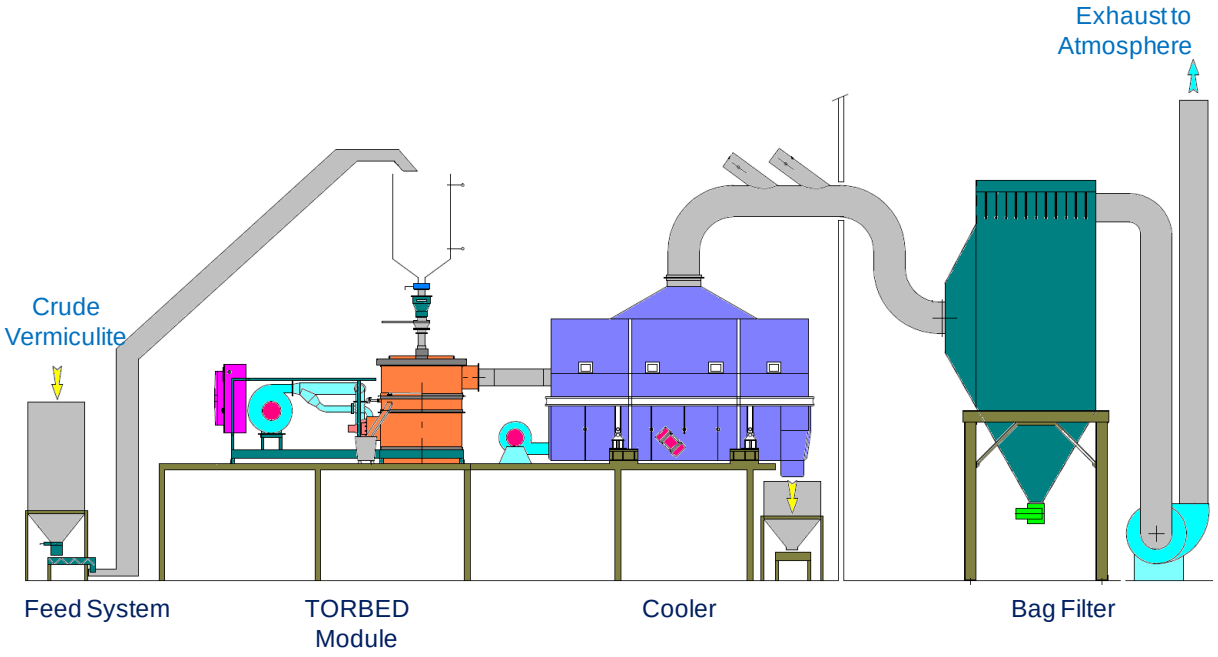

Figure 2: Typical Layout of TORBED T1000 Exfoliator Module with Cooler unit

Unexpandable material, such as grit, contained within the vermiculite crude ore is continually discharged from the TORBED Reactor during the process cycle.

Service Requirements - TORBED Reactors require an electrical supply, fuel (gas or oil) supply and an extract air system for the removal of the exfoliated material and the products of combustion.

1. Electrical Supply:

Electrical Supply	TORBED 1000
Voltage	380/415 V
Frequency	50 Hz
Phase	3 Phase + Neutral + Earth
Amps	32 A
Power	20 kVA

Note: *Alternative electrical supplies can be incorporated.*

2. Burner Fuel Supply:

a) Natural Gas - Calorific value 1000 Btu/ft^3 (37MJ/m^3)

Typical Consumption	TORBED 1000
Max. during warm up	100 m^3/h
Normal running	65 - 75 m^3/h
Supply pressure	6.5 kPa (26"WG)

b) LPG (Butane/Propane) – Calorific value 46,700 Btu/kg (49.3 MJ/kg)

Typical Consumption	TORBED 1000
Max. during warm up	75 kg/h (145 ℓ/h)
Normal running	50-56 kg/h (102 ℓ/h)
Supply pressure at burner	

c) Light Fuel Oil - 35 sec heating oil Calorific value 150,000 Btu/gall (36.4MJ/ℓ)

Typical Consumption	TORBED 1000
Max. during warm up	22 gall/h (1.66 ℓ/min)
Normal running	15 - 17 gall/h (1.20 ℓ/min)
Supply pressure at burner	170 - 200 kPa (25-30 psi)

3. Extract Air Requirements - 450ºC at -0.5" WG (-1.25mbar)

Volumetric Rate	TORBED 1000
Am^3/h	10,000
ACFM	5,890

The exfoliated material and the products of combustion are drawn from the Reactor through the same exhaust duct with the Reactor being maintained under a slight negative pressure.

TORBED Performance - Unlike most other production type Exfoliators, the TORBED Reactors do NOT rely on the crude vermiculite being fed directly into a flame. Within the Reactor, the crude vermiculite is tumbled within a high velocity hot gas stream until the exfoliation takes place. This gives the TORBED its unique and proven characteristic of being an extremely high rate heat transfer device thus causing very rapid exfoliation of the particles.

In common with other types of Exfoliators, there is a maximum amount of energy that may be imparted to the vermiculite ore. A major part of the energy required in the exfoliation process is that of overcoming the latent heat of vaporisation of water, hence the interlaminar water content of the ore becomes a vital factor when determining the throughput of a given source.

There will be variations in the achieved throughput and yield depending on the intrinsic properties of the vermiculite ore concentrate. It is known, for instance, that differences in the inter layer water and unexfoliable material (grit) contents exist between vermiculites from various geographical locations and also in different areas of the same deposit.

The majority of the data available at the present time relates to the performance of the TORBED processing South African ores from the Palabora deposit. This deposit has therefore been taken as the basis for the figures below.

Table 1: Performance of TORBED at 1220°C (2228°F) on Palabora vermiculite ore

Parameter	International Grade	U.S. Grade System	TORBED 1000 Max. Feed Rate	
			(kg/h)	(lb/h)
Raw Material Input Rate	G4 - Large	1	1,400	3,090
	G3 - Medium	2	1,700	3,750
	G2 - Fine	3	1,800	3,970
	G1 - Superfine	4	2,000	4,410
	G0 - Micron	5	2,000	4,410
Energy Consumption			1.25 - 1.58 GJ/tonne	

Table 2: TORBED Product Bulk Densities

International Grade	U.S. Grade System	Mean Exfoliated Bulk Density	
		(kg/m^3)	(lb/ft^3)
G4 - Large	1	65	4.0
G3 - Medium	2	75	4.6
G2 - Fine	3	85	5.3
G1 - Superfine	4	100	6.2
G0 - Micron	5	120	7.5

The above figures have been achieved during fully automatic and unsupervised operation over extended operating periods.

TORBED Exfoliators have also successfully exfoliated vermiculite ores from Russia, China, Brazil, Malawi, Zimbabwe, Kenya and North America**.**

Note: The above information is for general release and does not form any part of a specification and/or performance guarantee.

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