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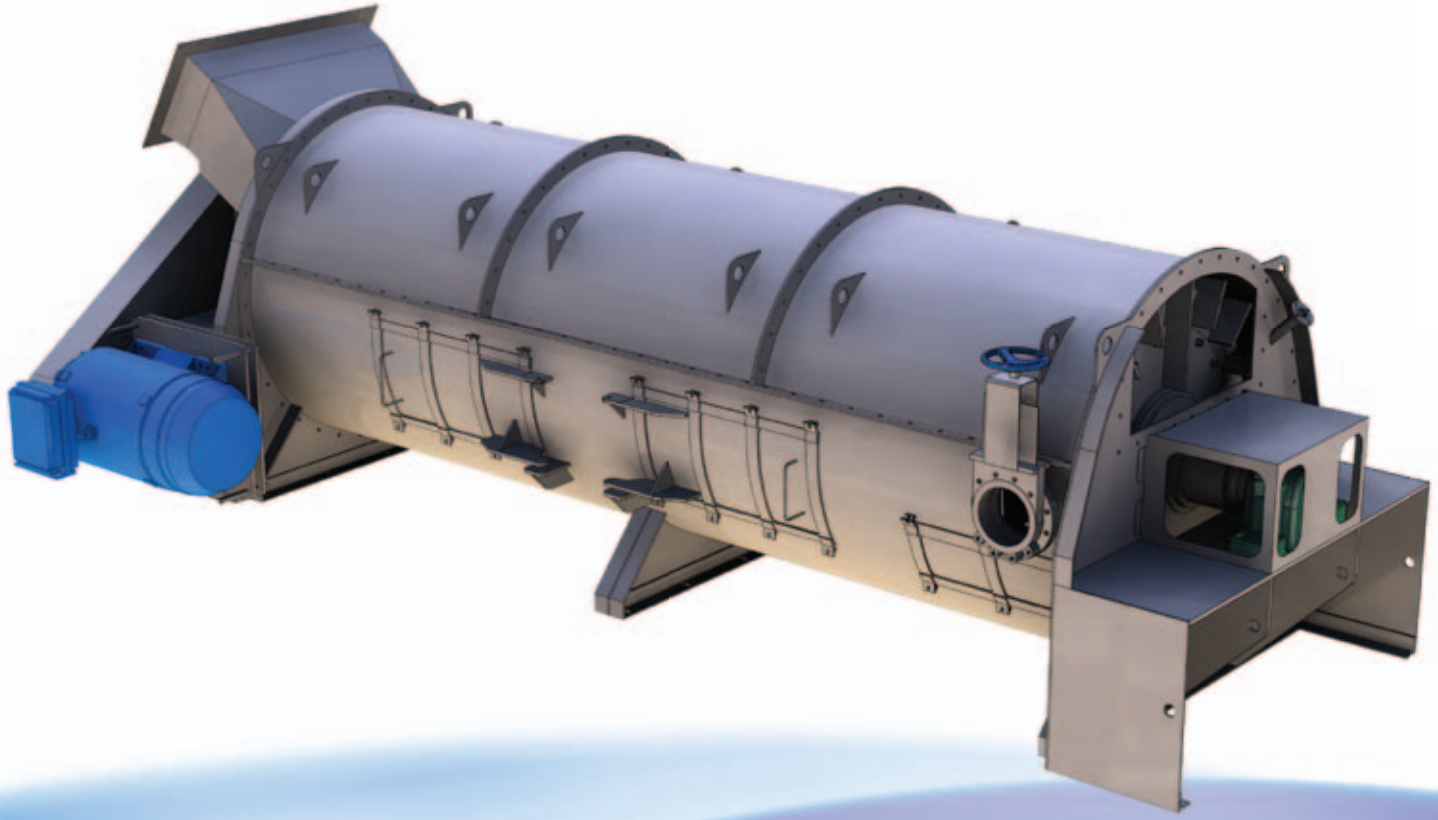
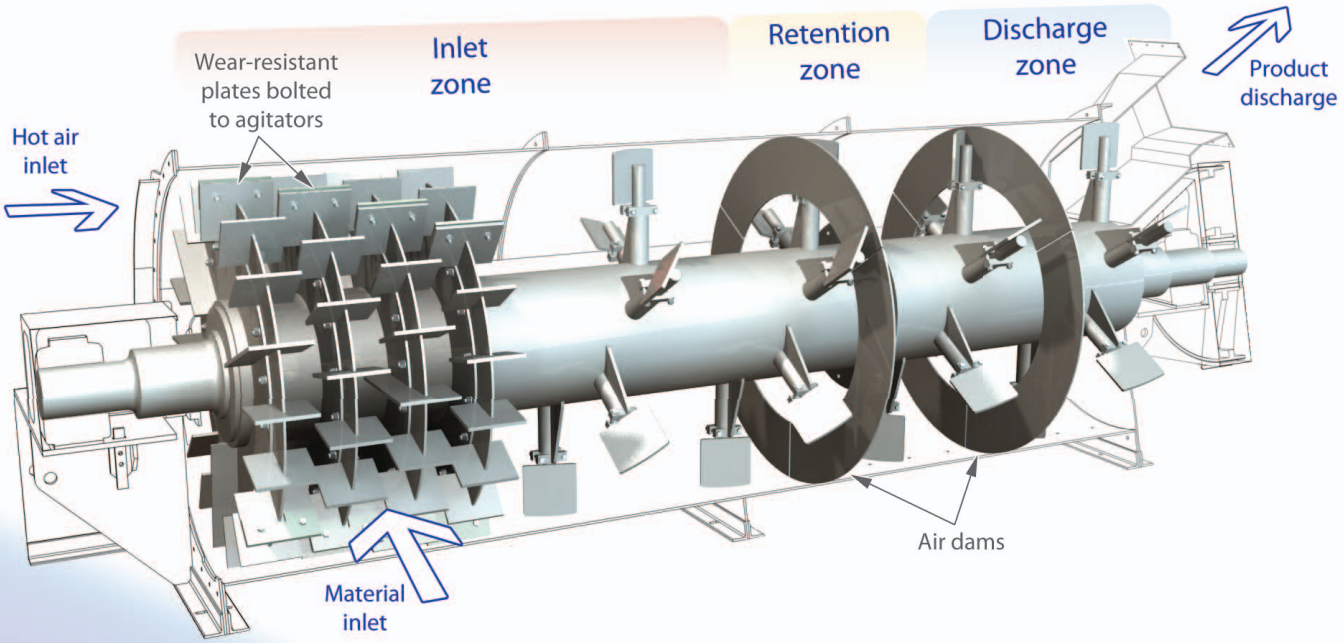


The AST Dryer

ATRITOR

The AST Dryer



The Air-Swept Tubular (AST) Dryer complements Atritor's range of drying mills, being uniquely capable of drying materials containing as much as 95% moisture without resorting to any form of feed conditioning. It is equally capable of processing relatively dry feed materials.

As the degree of turbulence and the residence time of the material in the AST Dryer are independently variable, the product can range in size from granular to powder. The residual moisture content of the product is a function of the Dryer exit temperature and product size, and can vary from more than 10% to less than 1%.

Evaporative capacities of between 380 kilograms per hour and 8,800 kilograms per hour are achievable.

Operating Principle

The function of the AST Dryer is to effectively expose the product to the heated process air stream and retain the product until it has reached the specified moisture content. The AST Dryer comprises three distinct zones with different operational functions.

1. Inlet Zone

The inlet zone achieves size reduction (when applicable) and the majority of moisture evaporation. This is accomplished using a highly turbulent agitator area and efficient mixing containing adjustable paddles.

The agitator plates (with a high density of fixed blades) work to break down the feed material into small pieces and provide a highly turbulent zone for efficient heat transfer. The smaller particles allow for more efficient heat penetration into the material and also allow the moisture to more easily escape as a vapour. The high velocity (50 to 60 metres per second) of the material in this zone further aids the efficient transfer of heat to the material.

This combination of velocity, agitation and a high temperature differential across the Dryer results in efficient and rapid evaporation. This zone of the Dryer is sometimes considered the "flash zone" of the unit.

Further downstream in this zone is a set of adjustable paddles that allows for back-mixing. Material that is still moist and potentially sticky will continue to be agitated and back-mixed via the adjustable paddles until it can be carried to the next zone in the air stream. The back-mix process is continuous with some material being carried over as new material is introduced.

At the division between the first and second zones of the Dryer is a set of "air dams", the purpose of which is to classify the material. Material that has been dried enough to be free flowing and easily conveyed in the air stream is carried on to the next zone.

2. Retention Zone

The retention zone is where the material's progression through the Dryer is slowed, and where further mixing and drying takes place. This zone comprises a series of mixing paddles which can be adjusted between conveyance and retention.

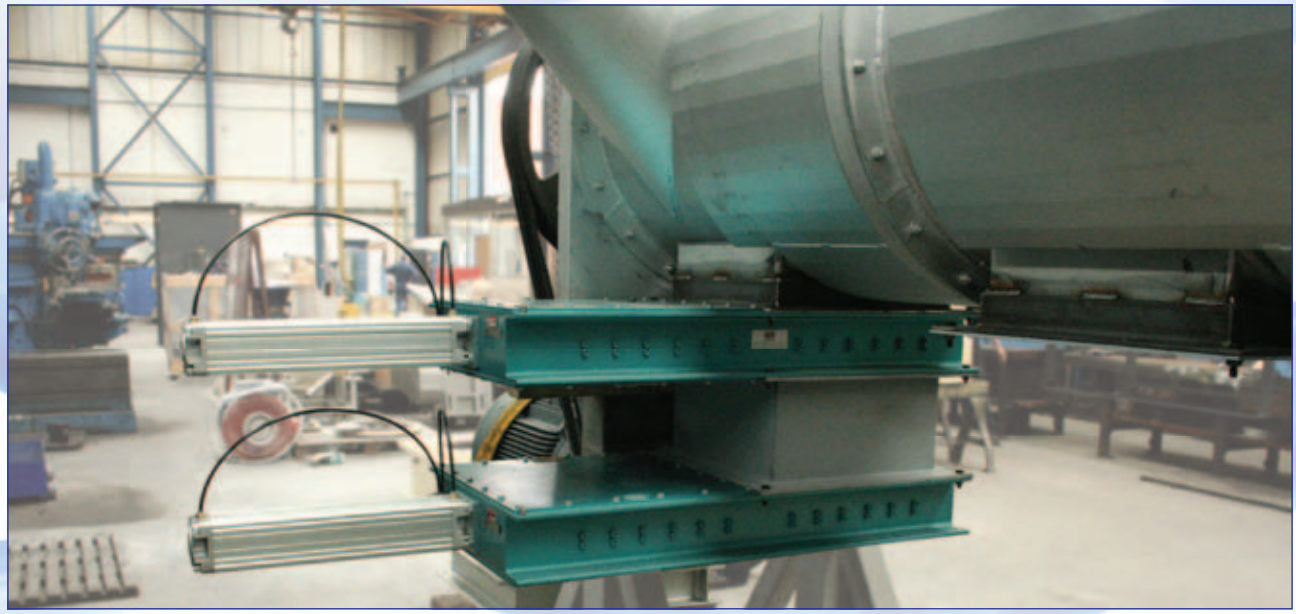
The air velocities in this zone are considerably lower than in the inlet zone. This lower velocity, combined with the effects of the adjustable paddles, allows the material to be retained in the unit for the length of time necessary to complete the drying process.

At the end of the retention zone is another set of air dams which aid in material retention and provide a further means of classification.

3. Discharge Zone

The discharge zone is similar in function to the retention zone, except that this zone also includes the product discharge. The final mixing paddles are typically orientated to convey the product out of the Dryer.

All adjustments to the internal parts can be done through large, hinged access panels in each zone of the Dryer. Cleaning can also be carried out via these panels.



This image shows a dump valve assembly fitted to the AST Dryer which allows moist or granular products to be discharged by gravity from the underside of the Dryer. The independently-actuated slide valves ensure the drying chamber remains completely sealed off from the atmosphere during discharge.

Process System

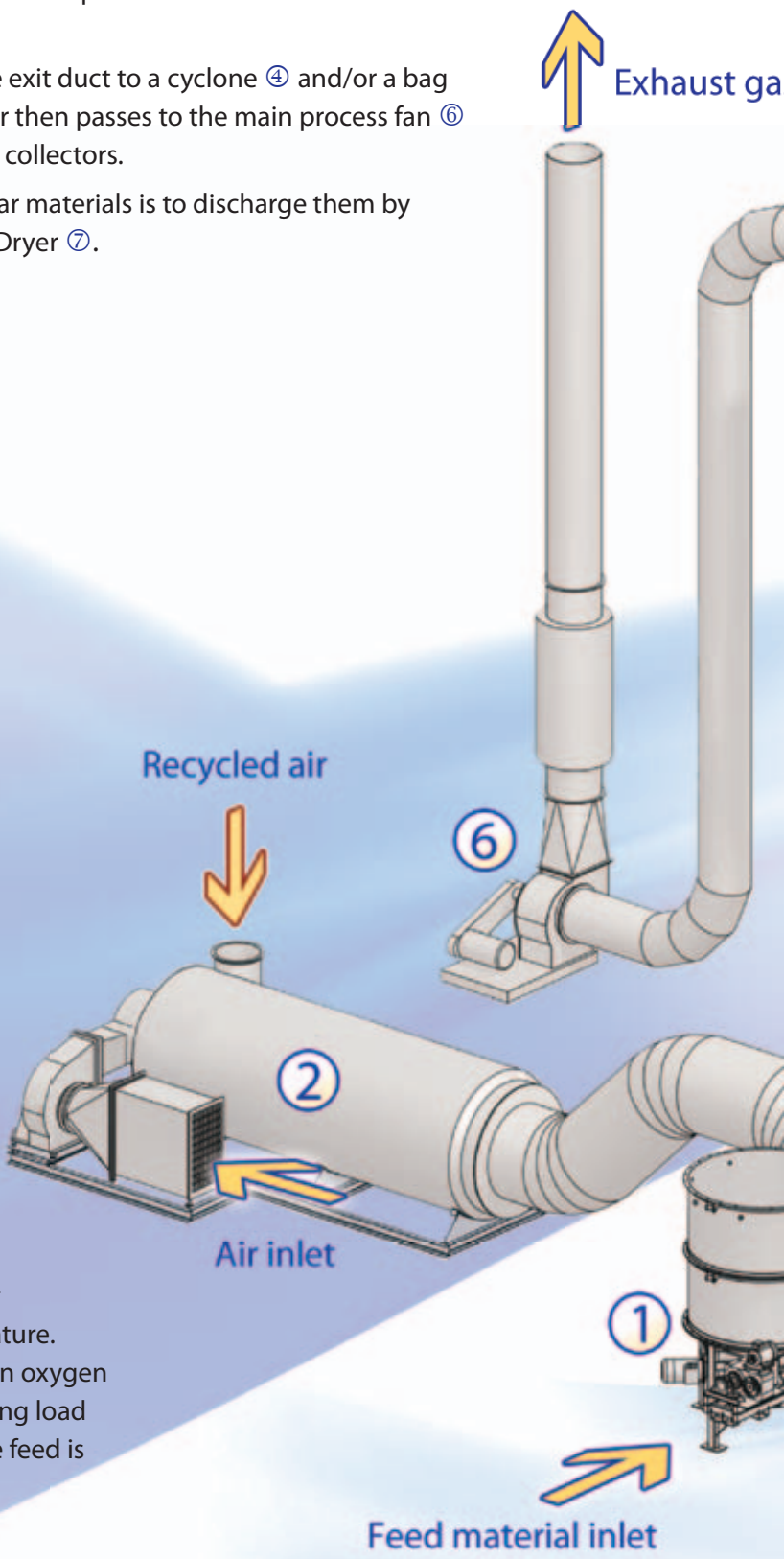
The AST Dryer is typically fed directly into the inlet zone by a variable-speed screw auger or a pump. A specially-designed mass flow feeder ① is available to work in conjunction with a volumetric screw. This device is extremely versatile and will process even the most difficult materials.

A hot air generator ②, mounted adjacent to or above the Dryer, provides air to the inlet of the Dryer at temperatures up to 600ºC. This is typically fuelled by natural gas, though other gases or oil are suitable. The fuel firing rate is controlled by a temperature instrument in the discharge duct of the Dryer. This temperature determines the residual moisture of the product and is therefore used as the process setpoint.

Air and dry material leave the Dryer ③ through the exit duct to a cyclone ④ and/or a bag filter ⑤ to separate the material from the air. The air then passes to the main process fan ⑥ and the product is discharged from the base of the collectors.

An option used for the production of moist, granular materials is to discharge them by gravity from the base of the discharge zone of the Dryer ⑦.

Product temperatures rarely exceed 60ºC.



System Inerting

The AST Dryer is an excellent tool for processing potentially explosive materials, as the entire system can operate under reduced oxygen conditions.

Exhaust gases are returned to the hot air generator where they are reheated to the Dryer inlet temperature. The proportion of returned gases is controlled by an oxygen analyser set to a safe process level. An artificial drying load is introduced to reduce the oxygen level before the feed is introduced.

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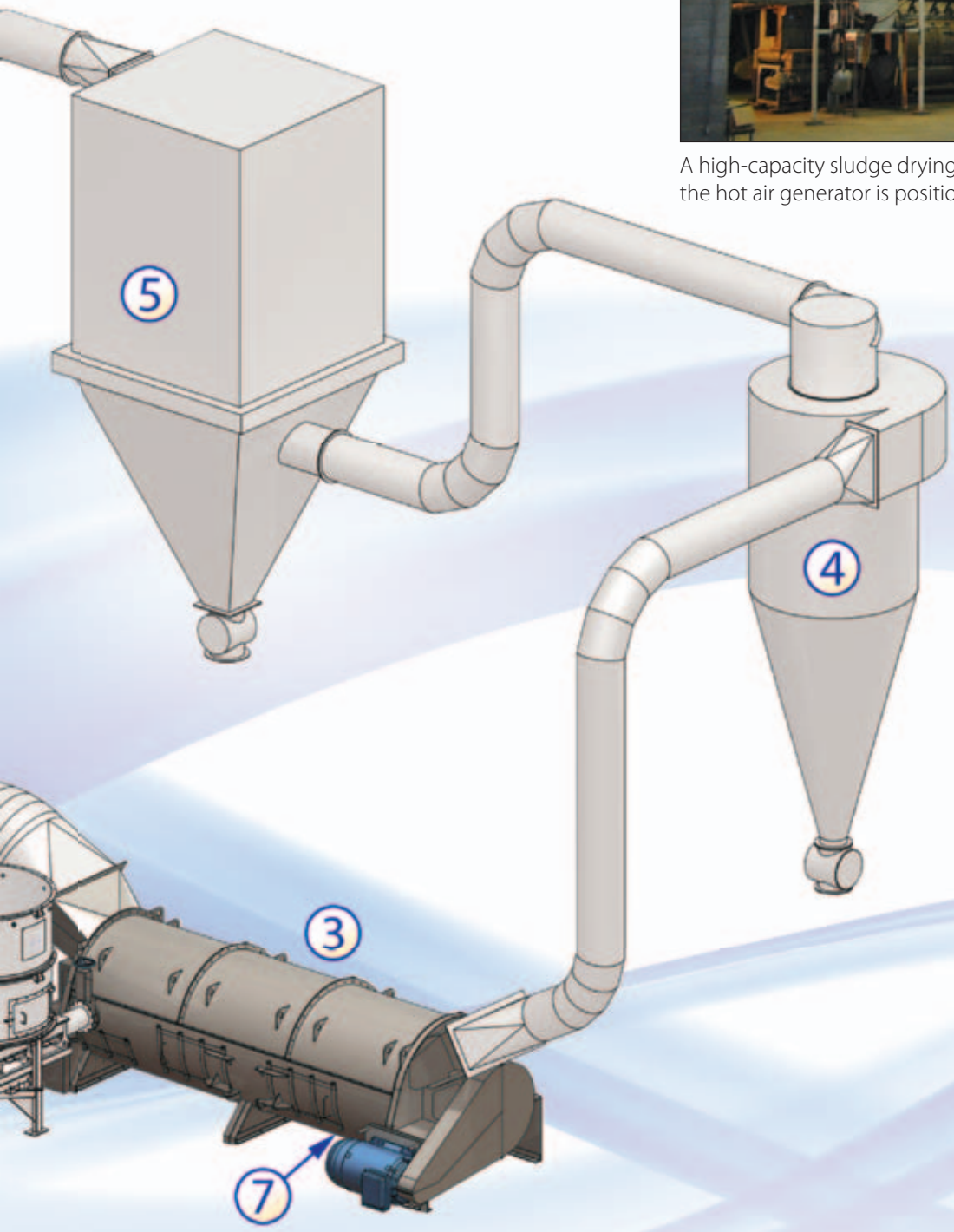
A large pigment-drying plant in the UK.

A high-capacity sludge drying plant in the USA. In this configuration, the hot air generator is positioned above the AST Dryer.

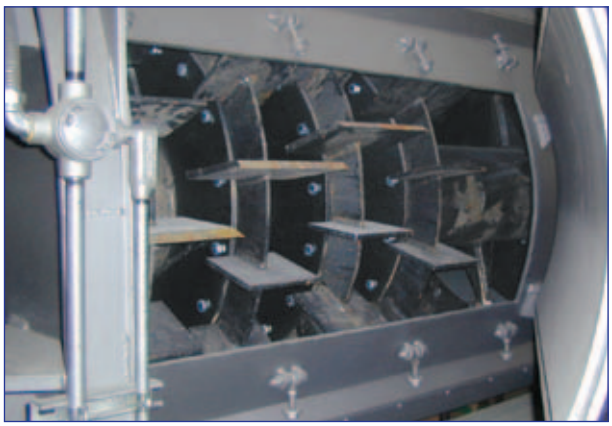


Materials of Construction

The AST Dryer can be manufactured in carbon steel, stainless steel grades 304 and 316, HASTELLOY® and abrasion-resistant steels. The internal components can be polished to fine grit finishes or coated with epoxy and other materials.

For abrasive feed materials the agitator blades are fitted with replaceable tips.

In special circumstances replaceable liners can be supplied.



The agitators in inlet zone of the AST Dryer viewed through one of the hinged access panels.

An AST Dryer for drying mica ready to be shipped to Finland.

A modular AST Dryer ready to be fitted with thermal insulation in the Atritor workshop.

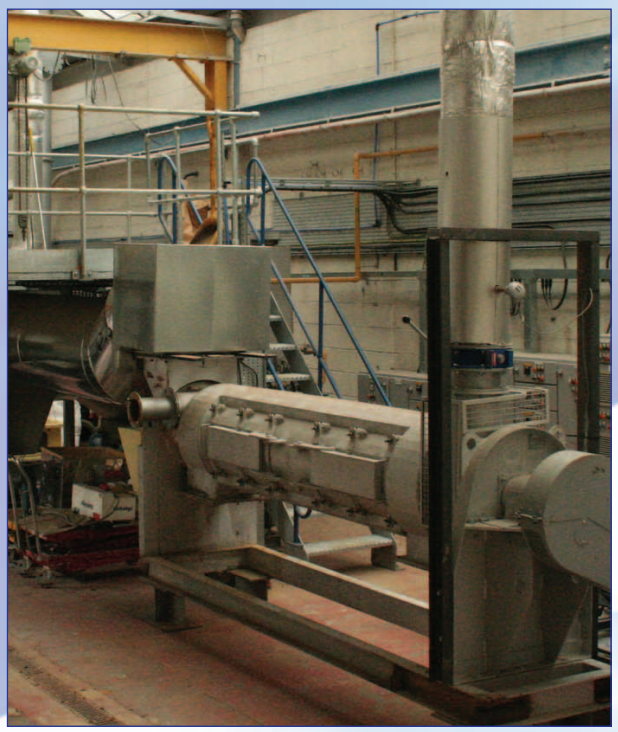
Test Facilities

To ensure customer confidence in the capabilities of Atritor equipment and processes, we operate a comprehensive pilot plant in Coventry where our range of equipment, including the AST Dryer, is available for client product evaluation trials.

All the equipment in the pilot plant is small production size, so all scaling is done within the range of production equipment.

The pilot plant is supported by an on-site laboratory, which includes laser particle size analysis equipment for comparing pilot plant products with reference samples.

The results achieved in the pilot trials provide the basis for system design and process guarantees.



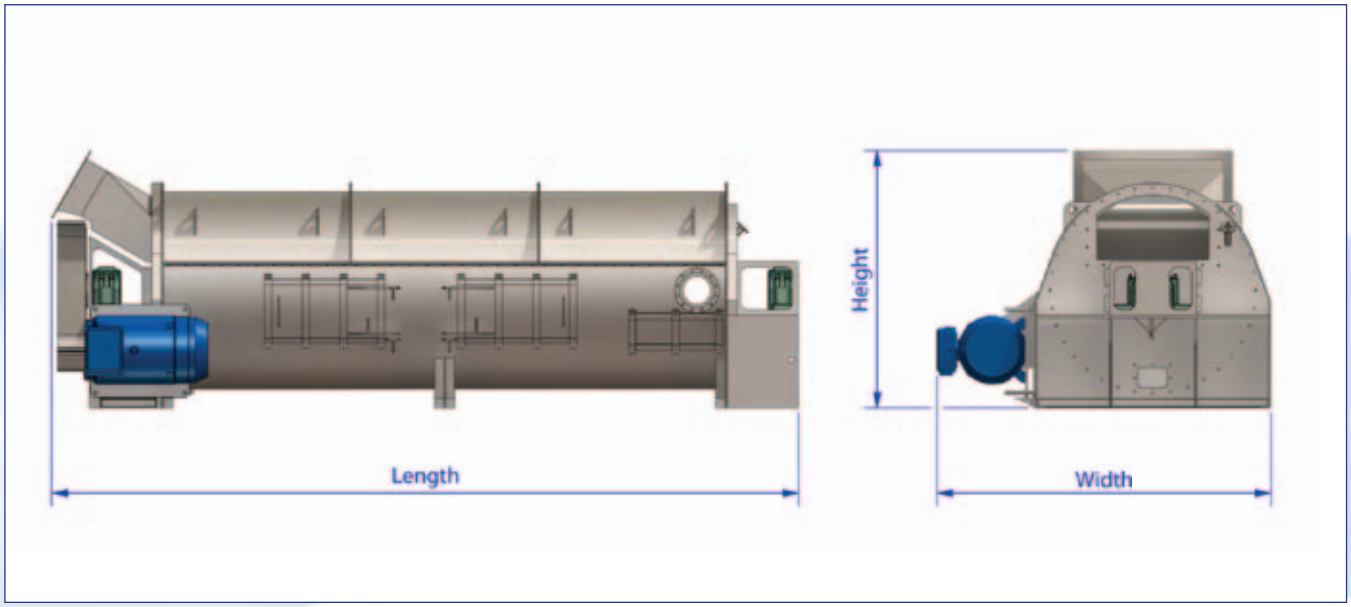
An AST Dryer available for customer trials in Atritor's test facility.

Typical Feed Materials

The following table lists a selection of materials that the AST Dryer is capable of processing.

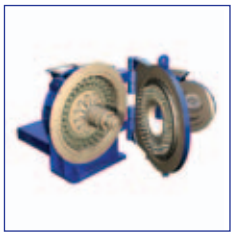
Alumina trihydrate	Citrus pulp	Iron oxides	PVC resin
Bentonite	Coagulated blood	Kaolin	Refuse-Derived Fuel
Bone meal	Coal fines	Leather waste	Sawdust chips
Brewer's grains	Coconut fibres	Magnesium oxide	Seaweed
Calcium carbonate	Coffee grounds	Mica	Sewage sludge
Cellulose	Feather meal	Municipal Solid Waste	Silica
Ceramic fibre	Gluten	Paper sludge	Soy protein
Cereals	Gypsum board	Pigments	Titanium dioxide
Chicken manure	Household waste	Pork skin residues	Wood flour

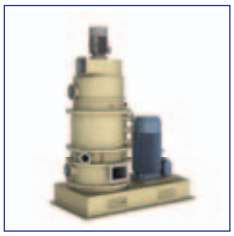
Technical Data

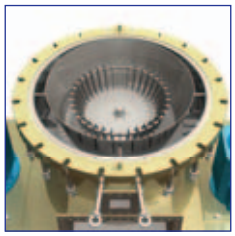


AST Dryer Model	Heat input	Air flow	Evaporation rate	Motor	Length	Width	Height
	x 10^6 kJ/h	am^3/h	kg/h	kW	mm	mm	mm
1610	1.0	2,500	380	15	3,900	1,200	850
2010	1.5	3,750	570	22	4,100	1,500	1,000
3012	2.5	6,250	750	45	5,100	1,800	1,250
3612	4.0	10,000	1,200	75	5,200	2,200	1,400
4815	6 - 9	22,500	2,650	110	6,700	2,900	1,800
6018	9 - 15	37,500	4,400	132	8,800	3,500	2,400
7220	12 - 18	45,000	5,250	200	10,400	3,800	2,700
8422	16 - 24	60,000	7,000	250	11,600	4,200	3,000
9624	24 - 30	75,000	8,800	300	12,200	4,600	3,350

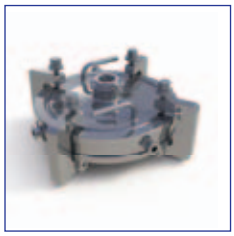
Other Equipment in the Atritor Range


Dryer-Pulveriser


Cell Mill


Air Classifier Mill


Turbo Separator


Microniser

Complete Engineered Solutions

Atritor Limited has a long history and extensive expertise in providing complete turn-key process plant. We are able to fully specify all ancillary equipment, both within the immediate drying process and beyond.

We can provide the following services to ensure complete customer satisfaction:

- Research and development of products and processes
- Pilot plant facilities for all equipment in our range
- Full process plant design using the latest **AutoCAD**® and **SolidWorks**® software
- Quality control to ISO 9001:2008
- Design and supply of PLC-based control systems
- Supply of all equipment for a complete process
- Full installation service
- Experienced engineers for commissioning and operator training
- Process guarantees
- After sales service and spare parts supply

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All Atritor equipment is built to the rigorous standards of ISO 9001:2008

Certificate No. FM 11960