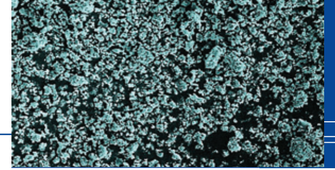


PRINCIPLE OF OPERATION AND DESIGN FEATURES

PRINCIPLE OF OPERATION

Table roller mills operate in accordance with the principle of pressure comminution, making them suitable for brittle feed products. The product is subjected to compressive stress between the grinding table and the grinding rollers. The specific grinding force (contact force divided by the cross-sectional area of the grinding roller) is adjusted according to material properties in the range between approx. 0.5 and 1 N/mm², whereby the effective pressures in the material bed are naturally much higher.

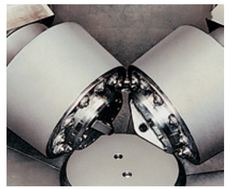
The grinding table is set into rotation by a motor and suitable gear unit, whereby peripheral speeds of between 2 and 6 m/s are employed. Because the gear unit has to absorb the forces of the grinding rollers, it is equipped with an axial friction bearing (segmented bearing). The product is fed to the centre of the grinding table where centrifugal force conveys it across the grinding table to the periphery. The grinding rollers roll over the product repeatedly during this time and crush it. The grinding rollers are pressed hydraulically against the grinding table, whereby fluctuations in the hydraulic pressure that occur in operation are buffered by the hydraulic gas accumulator charged with compressed air. The grinding table is equipped with a weir at its edge; the height of the weir can be chosen to set the residence time of the product in the grinding zone.

A nozzle ring is located around the grinding table from which the incoming air exits at high speed. The comminuted product is conveyed upwards to the integrated air classifier; the rejected coarse material is returned to the grinding table for further comminution. The end product is separated from the air in a downstream collection unit.

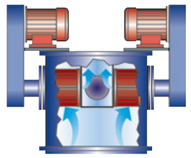
FEATURES

A fundamental feature of Alpine's table roller mill is the optimised kinematics of the grinding rollers and grinding table to permit the production of large amounts of fines. In combination with a Turboplex ultrafine classifier ATP, this now makes it possible to manufacture end products with a table roller mill that have a fineness of d97 = 10 µm.

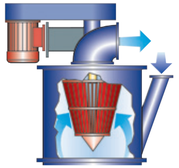
- Three grinding rollers, each with two hydraulic cylinders to generate the requisite compressive force
- Rollers can be hinged out of the machine hydraulically for maintenance.
- Wear parts are easy to exchange.
- Compact design
- High quality gear units from renown manufacturers.
- Highly wear-resistant construction materials for grinding table and grinding roller jacket are standard.
- Low specific grinding energy.
- Integrated air classifier with sharp top-size limitation; selection of classifier to suit the desired end-product fineness.
- Fineness range between d97 = 10 µm and approx. 200 µm
- Mill drive with frequency converter to permit optimum adaptation of the mill to a wide range of particle sizes.
- Mill control by means of the drive power or differential pressure monitoring.
- Option: hardfaced plates as wear protection in the mill and classifier housing.
- Option: design for hot-gas operation to dry the product.
- Option: discharge of coarse material via a discharge screw.



GRINDING ROLLERS AND GRINDING TABLE



SECTION THROUGH THE TURBOPLEX-MULTIWHEEL CLASSIFIER



SECTION THROUGH THE MICRON CLASSIFIER

PROCESS TECHNOLOGIES FOR TOMORROW℠

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AWM 10.06/2 e

TABLE ROLLER MILL AWM

Powder fineness to d_{97} = 10 µm

HOSOKAWA ALPINE Aktiengesellschaft

Hosokawa Alpine is a member of the Hosokawa Micron Group, responding to global needs through emphasis on materials science and engineering. The Group is an international provider of equipment and technology for powder and particle processing, plastics processing and confectionery products. The Group maintains facilities for research, engineering, manufacturing and service in each of the world's major industrial markets.

HOSOKAWA ALPINE

PROCESS TECHNOLOGIES FOR TOMORROW℠

POWDER AND PARTICLE PROCESSING

AN ESTABLISHED CONCEPT WITH NEW ADVANTAGES

APPLICATIONS

Our established experience in high-compression roller milling, for example the Alpine high-compression roller mill ECP in combination with Alpine's fine and ultrafine classifying technology enabled us to accomplish a wide range of process-technological specifications in the mineral powder sector. Not only soft materials such as limestone and talc, but also hard materials such as dolomite or phonolite etc. can be processed with the new developed AWM.

The table roller mill is a robust and reliable mill suitable for processing medium-hard mineral raw materials.
For many years, however, the fineness range of these mills was limited to end products not finer than d_{97} = 40 – 60 µm. This was attributed on one hand due to the lack of a modern classifying stage and on the other hand to the design of the grinding chamber, especially the table and roller geometry.
Hosokawa Alpine retained the well-known advantages and refined the grinding technology to develop table roller mills for ultrafine end products down to d_{97} = 10 µm.
A complete size range of these optimized mills was developed to address present as well as future industry requirements.

FEATURES

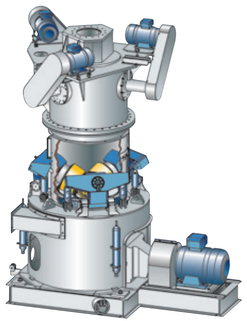
Typical ALPINE table roller mill characteristics:
- Compact design
- High throughput
- Low energy consumption
- Sharp top-size limitation of the products due to the fine/ultrafine classifier integrated into the top section of the mill.

AWM table roller mills have proven themselves in many field installations. Compared with ball mills, table roller mills are superior as a result of their:

- Smaller foundations
- Simple system set-up
- Lower noise level
- Easy change of product fineness
- Very flexible operation over a wide range of fineness (d_{97} = 10 - 150 µm)
- Easy change of product
- Lower specific energy consumption
- Suitability for flash drying.

COURTESY SÜD-CHEMIE

COURTESY RIGIPS

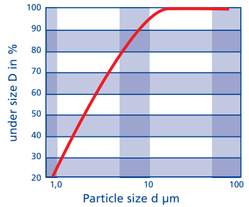


TYPICAL APPLICATIONS

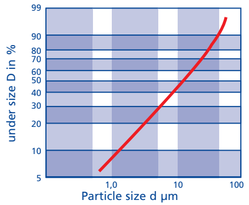
Application examples,
specific energy for grinding (related to complete system)

1200 AWM with integrated Micron Classifier MS 4	**Natural gypsum**	Fineness 99 % < 100 µm Throughput 16 t/h $E_{spec.}$ < 12 kWh/t
960 AWM with integrated Micron Classifier MS 4	**Dolomite**	Fineness 97 % < 63 µm Throughput 2,7 t/h $E_{spec.}$ < 60 kWh/t
1200 AWM with integrated Micron Classifier MS 4	**Petroleum coke**	Fineness 97 % < 90 µm Throughput 5 t/h $E_{spec.}$ < 40 kWh/t
960 AWM with integrated Turboplex-Classifier 630 ATP	**Talc**	Fineness 97 % < 20 µm Throughput 1,2 t/h $E_{spec.}$ < 60 kWh/t
1200 AWM with integrated Micron Classifier MS 4	**Limestone** (grinding and drying)	Fineness 97 % < 90 µm Throughput 15 t/h $E_{spec.}$ < 10 kWh/t H_2O evaporation: approx. 750 kg/h
1200 AWM with integrated Micron Classifier MS 4	**Bentonite**	Fineness 0,1 % > 45 µm Throughput 4,4 t/h $E_{spec.}$ < 55 kWh/t

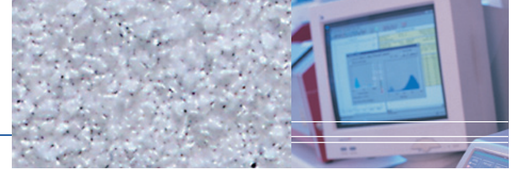
Curve 1:
Particle size distribution of limestone after processing with the 1200 AWM.



Curve 2: Particle size distribution of dolomite after processing with the 960 AWM



Product line AWM	Type	400	600	960	1200	1500	1800	2000	2400
Scale-up factor F = approx.		1	2.5	7	12	20	30	40	60
Table diameter	mm	400	600	960	1200	1500	1800	2000	2400
Mill drive	kW	15	37	75-90	110-160	200-250	315-355	400-500	560-710
Classifier ATP	**Type**	**200**	**315**	**630**	**750**	**1000**	**630/4**		
Classifier drive	kW	5.5	11	30	37	55	4 x 22		
Max. classifier speed	rpm	6000	4000	2000	1600	1200	2000		
Air flow rate	m³/h	1200	3000	8400	14400	24000	36000		
Classifier MS	**Type**	**MS-1H**	**MS-2H**	**MS-4H**	**MS-4H**	**MS-5H**	**MS-6H**	**MS-6H**	**MS-7H**
Classifier drive	kW	5.5	11	22	30	55	75	75	110
Max. classifier speed	rpm	5000	3300	1600	1600	1100	800	800	600
Air flow rate	m³/h	1400	3500	10000	17000	28000	42000	56000	84000



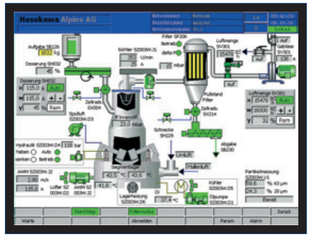
AWM FLASH DRYING / GRINDING SYSTEM

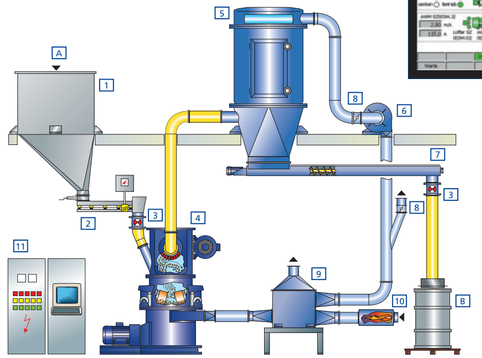
Processing system with heat recovery system, i.e. the heat generated by the fan and the mill/classifier is used in combination with part of energy released from the condensate to preheat the process air.
This system arrangement allows approx. 30% energy savings for the gas burner.

FILLING LEVEL CONTROL

The filling level of the Alpine table roller mill can be controlled in three ways:
1) As a function of the table motor as measured by the current.
2) As a function of the differential pressure of the material bed on the grinding table.
3) A combination of the above two parameters.

If the entire fineness range is to be produced with one mill, the peripheral speed of the grinding table has to be controlled by means of a frequency converter. State-of-the-art PLC technology allows fully automatic operation.





1 Feed Silo
2 Feeding device
3 Rotary valve
4 Table roller mill AWM
5 Automatic reverse jet filter
6 Fan
7 Conveying screw
8 Throttle valve
9 Heat exchanger
10 Gas burner
11 Control panel

A Feed product
B End product

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