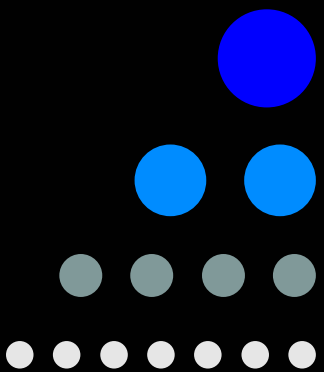
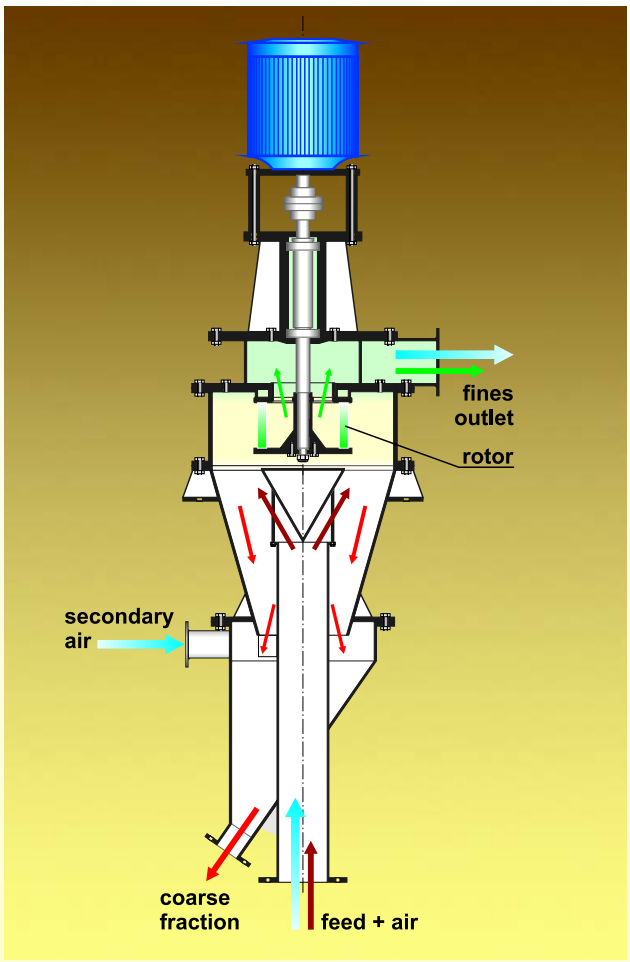
air classification

acx classifier series



Comex

air classification



Classifier cross section

The air classification process is of critical importance for many grinding operations. In general, the overall energy consumption for grinding can be reduced drastically, if classification efficiency is high. Furthermore, the production capacity can be significantly increased, which for many applications is even more important than energy savings. When air classification is only considered to produce different size fractions without grinding, high efficiency will be even more important to provide products of required particle size distribution. Often, different size fractions are required, which have a specific particle size distribution curve. Efficient classification is of critical importance in such applications.

The Comex air classifier has been developed at SINTEF/NTNU laboratory in Norway. The feed material enters the classifier mixed with an air stream, through a vertical pipe positioned at the bottom of the classifier. The particle stream entering the classifier is dispersed around a static distribution cone, where coarse particles immediately begin to settle in the lower velocity air stream. These particles are rejected towards the conical outlet and fall down to the bottom part of the classifier. As they are falling to the bottom of the classifier, they pass through an area where secondary rinse air is introduced tangentially, in a swirling motion, to wash off fine particles that might be adhering to the coarse material.

ACX 200 classifier

fine classification

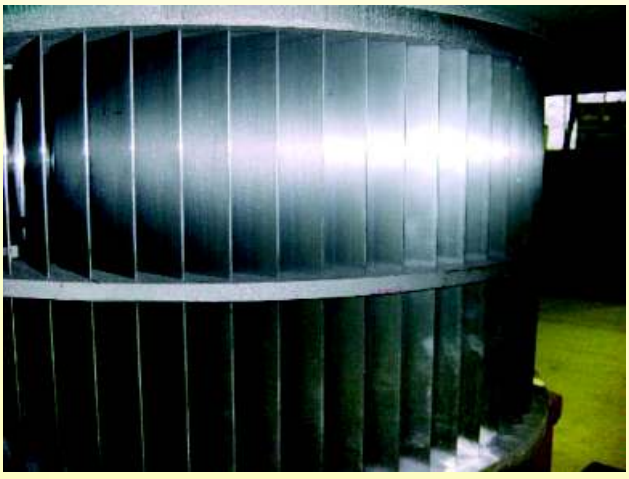
The fine particles are swept up towards the classifying rotor, while the coarse material is discharged from the classifier, by gravity, through the coarse fraction outlet. The finer fractions presented to the classifying rotor, are selected or rejected according to the resultant of a positive air drag force opposing a negative rejecting centrifugal force, developed from the rotor speed. The selected fine fraction flows through the rotor and is discharged from the classifier through the air outlet, together with the air flow. The fine fraction is separated from the air in a downstream cyclone or filter.

The most important design features which make the classifier unique, are:

- Pneumatic transport of the feed material to the classifier, which provides excellent dispersion of the material in the air during a turbulent flow inside the inlet pipe.
- The distribution cone for the feed stream entering the classifier is static, reducing it's wear rate in abrasive applications.
- There are no collisions between the entering trajectories of the feed and the descending coarse stream inside the classifier. This prevents mixing of the fine particles from the feed stream with the coarse particles flowing to the classifier outlet. Consequently, higher classification efficiency is achieved. At this point, coarse material is immediately rejected in the lower velocity air stream avoiding contact with moving parts in the classifier, leading to increased process volume opportunities for a given rotor size, and again, less wear on the rotor.
- The feed material stream flows around the rotor at a negative angle to the rotor surface, with no direct mechanical contact of the feed with the rotor parts. Thus, only particles similar in size to a cut point, flow close to the rotor surface. This element increases classification efficiency and dramatically reduces the wear rate of the rotor.
- Rotor geometry and angular blade position make it possible to achieve much finer products than with traditional construction.
- The main air-fine fraction outlet is spiral shaped, hence kinetic energy of rotating particles and air molecules is easily transferred to positive displacement at the outlet pipe. This is of critical importance, providing lower pressure loss during classification.

This results in the following benefits from application of the Comex air classifier:

- High classification efficiency
- Large processing capacity, from smaller units
- Ultrafine cut size down to D97 of 2 microns
- Low pressure and power loss
- Low wear rate of the moving parts
- Reduced maintenance and operating cost



ACX 900 classifier rotor

Size range

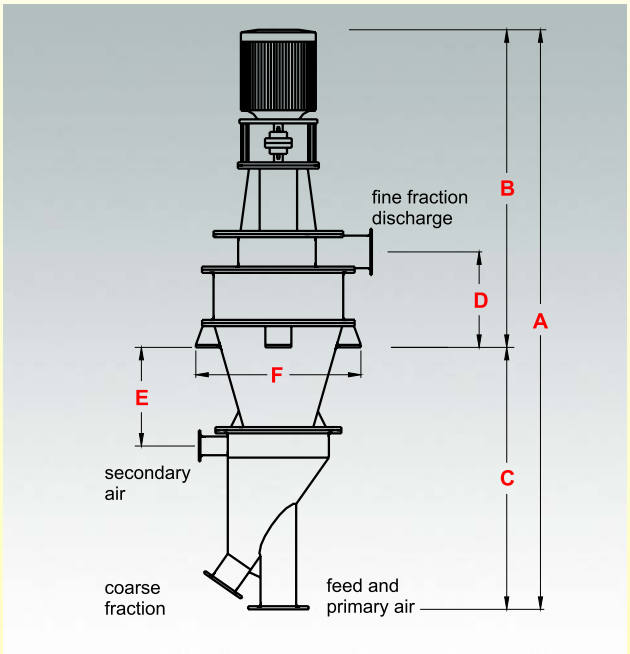
Comex air classifiers have been operating in industrial applications since 1994. Initially in industrial minerals and more recently in materials with many different properties. The classifiers have different rotor sizes, ranging from 200 mm diameter up to 1500 mm diameter. Production capacity ranges from 1200 kg/h to 75 t/h.

air classification

Tables below show the range of classifiers including the most important operating and construction parameters. The ACX 200 is used in pilot plants, for carrying out small scale investigations, or for classifying the finest of products.

Comex air classifiers ACX

Classifier size - ACX	200	350	500	700	900	1200	1500
Scale factor	1	3	6.25	14	20	36	56
Blower motor power [kW]	5.5	15	30	45	55	110	200
Classifier motor power [kW]	4	7.5	15	22	30	37	45
Rotor maximum speed [1/min]	6000	3300	2300	1550	1300	950	760
Capacity max. [t/h]	1.2	3.5	8	16	28	50	75
Air flow rate [m^3/h]	800	2500	5 000	10 000	16 000	28 000	45 000
Product fineness D97 [µm]	2-110	3.5-130	4.5-140	6-160	7-200	11-220	15-250



ACX 900 under production

Classifier weights and dimensions [mm]

Classifier size - ACX	200	350	500	700	900	1200	1500
Approximate weight [kg]	300	950	1800	3100	4000	7500	10500
A	1850	3050	4410	5656	6695	8730	10610
B	1020	1580	2310	2761	3495	4485	5310
C	830	1470	2100	2895	3200	4245	5300
D	310	530	775	1100	1500	1995	2480
E	320	560	800	1050	1035	1390	1730
F	530	925	1324	1760	2340	3125	3900

Energy saving potential

Due to it's unique design, the Comex air classifier provides high classification efficiency and simultaneously gives a very low pressure loss during operation. This is of critical importance when the overall energy for material processing is considered. In some applications for industrial minerals, the Comex classifiers provided a production increase of 80 - 120 % after replacing older classifiers. The table below shows some examples of material processing using Comex air classifiers. Considering closed circuit grinding when the air classifier is used together with the grinding equipment, a very efficient process can be achieved. Examples below show the closed circuit grinding with different types of mills and the ACX classifiers. The production parameters and materials resulting from these processes are often not possible using alternative classification and grinding equipment.

Examples of specific energy requirement and yield efficiency for some classifier applications

Material type	Product fineness D97 [µm]	Yield efficiency [%]	Specific energy for classification [kWh/t]
Dolomite	7.2	42.2	33.5
Dolomite	1.9	23.9	50
Feldspar	7.5	62.4	42
Feldspar	5.9	40	35.3
Lime	57	84	5.1
Lime	10.7	95	9.3
Cement	22.6	67.5	5.6
Cement	9	55	12.8

Grinding examples for the ACX classifier and the high intensity mill circuit

Barytes	Feed	P 1	P 2
D97 [µm]	46.8	2.3	2.5
D80 [µm]	25.2	1.5	1.6
D50 [µm]	11.8	1.0	1.1
Specific energy for grinding [kWh/t]		122	107

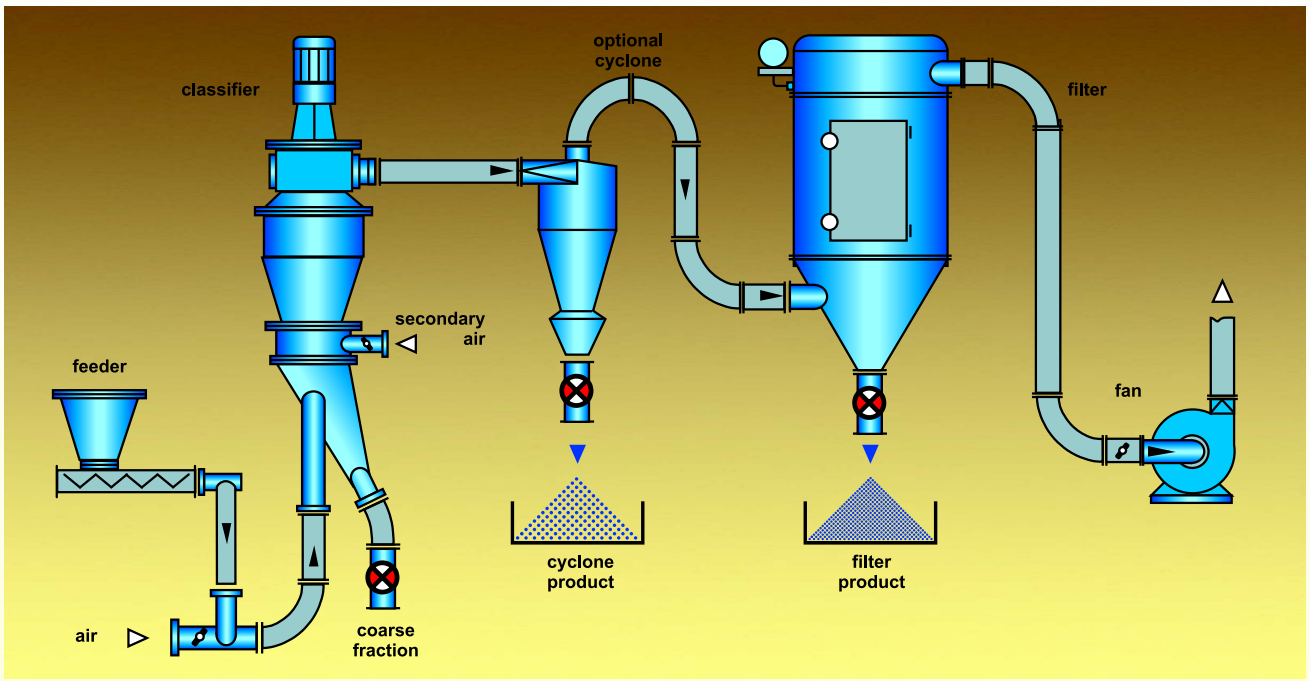
Calcium carbonate	Feed	P 1	P 2	P 3
D97 [µm]	28.0	10.8	5.3	2.6
D80 [µm]	16.9	5.8	2.9	1.6
D50 [µm]	9.6	2.7	1.6	0.98
Specific energy for grinding [kWh/t]		39	57	114

Grinding examples for the ACX classifier and the ball mill circuit

Dolomite	Feed	P 1	P 2
D97 [µm]	400	54	39
D80 [µm]	390	31	22
D50 [µm]	220	17	11.5
Specific energy for grinding [kWh/t]		25.5	34.5

Feldspar	Feed	P 1	P 2
D97 [µm]	480	41	19
D80 [µm]	360	26.5	11.3
D50 [µm]	280	14.1	5.3
Specific energy for grinding [kWh/t]		26.2	56.2

air classification



Configuration of the air classification circuit

Example of the multiple size production plant

Applications

Comex air classifiers can be applied to processing of various materials having different physical properties. High classification efficiency can be obtained with materials that are difficult to disperse. Furthermore, thanks to its unique construction and thus low wear rate of moving parts, this type of classifier provides a high application potential for processing abrasive materials and high purity products. The ACX classifiers were successfully tested and applied to the production of:

- mineral concentrates
- abrasive materials
- fillers for paper, rubber, paint and plastic
- raw materials for microelectronics
- raw materials for fibre optics
- advanced composite materials
- construction and building materials

Comex air classifiers can basically be operated in two configurations. The first configuration is

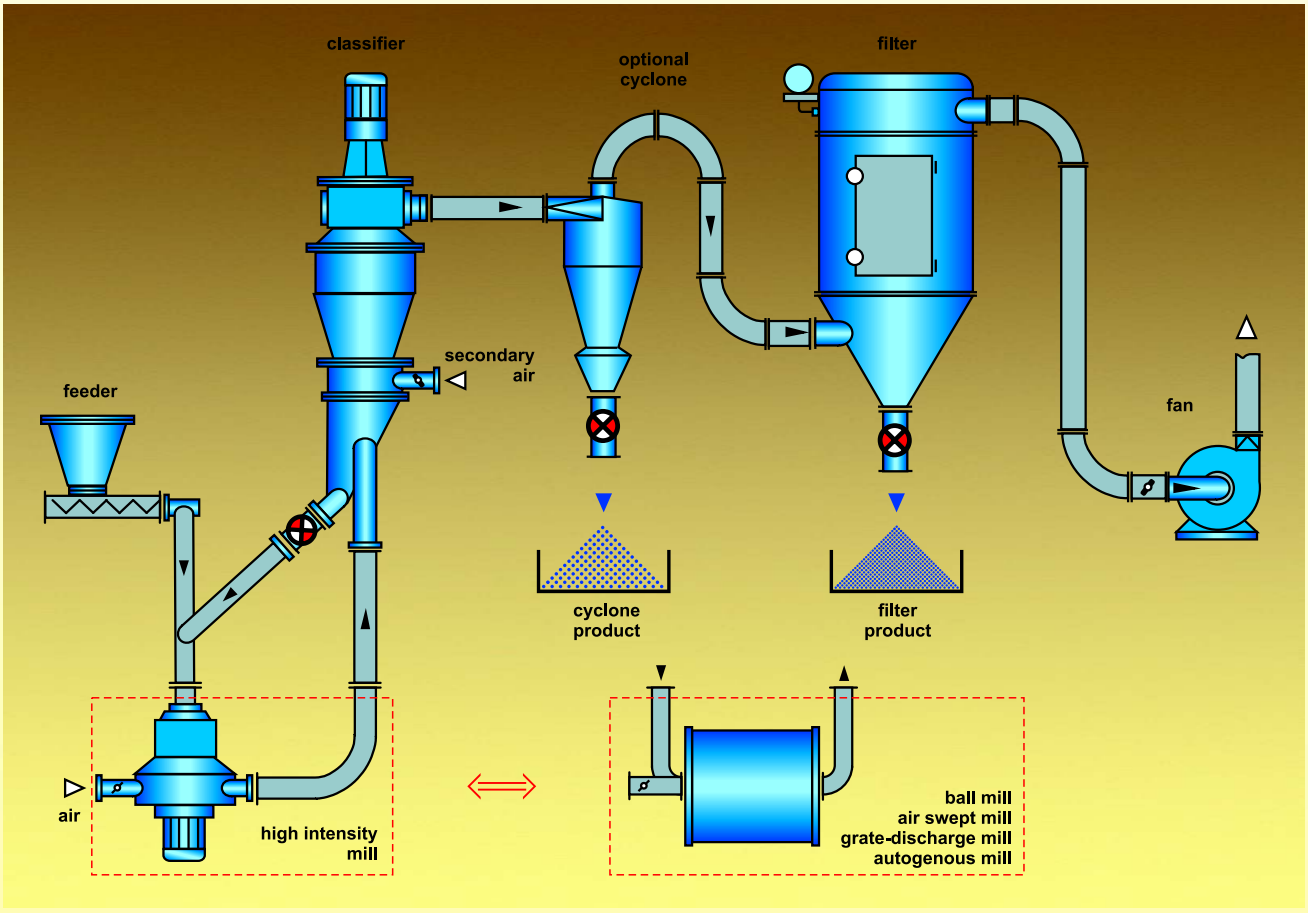
related to particle separation where the feed material is to be classified into coarse and fine fractions. The main advantage of the efficient classification process is then expressed in the particle size distribution of the coarse fraction being free from the fine grains. High recovery of the fine stream is another important parameter being critical for the production rate of a circuit.

The second basic classifier configuration is related to the closed circuit grinding with milling equipment. Comex air classifiers are often used in grinding circuits where their high classification efficiency provides an additional benefit in an increased production rate. ACX classifiers were successfully tested and applied in the circuits employing high intensity mills, ball mills, air swept ball mills, grate discharge mills and autogenous mills.

Research and Development

Comex offers extensive test and development facilities where different products can be accurately tested prior to final design, for determination of the optimal process. The pilot scale facilities include different sizes of ACX classifiers together with a wide range of grinding equipment. Extensive instrumentation of the pilot scale circuits, including on-line particle size measurement, makes it possible to achieve best operating conditions.

Grinding circuit configuration



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