

A large industrial dairy processing tank with a worker on a platform. The tank is made of stainless steel with a grid of pipes and valves. A worker in a white lab coat and cap is standing on a metal platform, looking at a circular panel on the tank. The background is a bright blue sky.

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A new generation of
CIP-able bag filters
by Vagn Westergaard ●

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A new generation of CIP-able bag filters

By Vagn Westergaard

Powder recovery from spray dryer exhaust systems for food and dairy products has in the past typically been done in cyclones, either alone, where environmental issues have not been in focus, or, where stricter requirements are enforced by the authorities, cyclones combined with wet scrubbers or textile bag filters.

While requirements to environmental protection, energy consumption, noise level, production efficiency and product quality are increasing everyday for the food and dairy industries, powder manufacturers have witnessed a development especially for powder recovery systems. Based on almost 10 years of research, development and testing of a CIP-able bag filter by Niro A/S, the SANICIP™ filter has now reached a point where it is setting the standard for almost all dryers.

The pros and cons of these powder recovery tools are listed in table 1.

The SANICIP™ Bag Filter and how it works

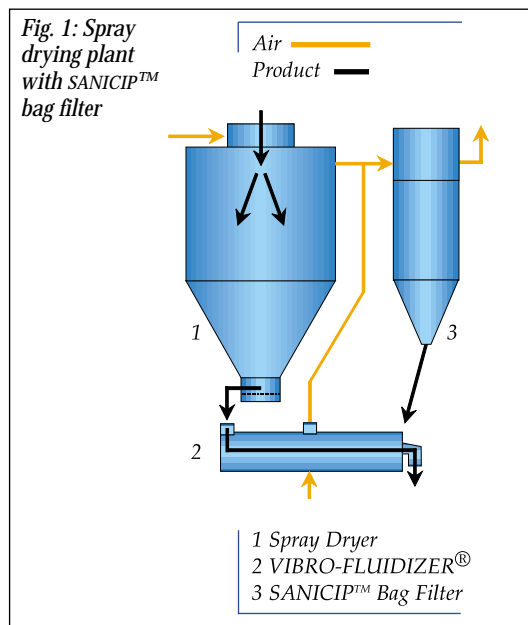
The SANICIP™ bag filter is of the reverse jet type and made of stainless steel. It consists of a cylindrical bag housing with spiral shaped air inlet, clean air plenum on top, and a conical bottom with fluidized powder discharge. During opera-

tion the product collected on the outside of the filter material is removed by a compressed air jet stream from the inside of each bag. The bags are clean-blown individually, resulting in a very even discharge of powder and using higher air-to-cloth ratios. The frequency and duration of the cleaning sequence can be adjusted to suit actual running conditions.

The bag filter housing is insulated on the cylindrical part below the hole plate and is in a fully welded execution. The supply air system for the fluidizing bottom has a multiple purpose: During production the cone of the bag house is first heated by the warm air, which subsequently is used for fluidizing the powder in the bottom. This ensures an even powder flow out of the bag house. During standstill the air is used for heating of the cone alone and is in a closed loop. Condensation and risk of mould growth is therefore avoided.

The filter bags are made from a special 3-layer gradient polyester material, which is heat-treated to give a special dust-releasing surface. Each bag is supported on a stainless steel cage and is easily dismantable. In normal bag filters and old design CIP-able bag filters the clean-blowing of the bags is performed by using a venturi protruding into the top part of the bag, a solution that works, however, the

Fig. 1: Spray drying plant with SANICIP™ bag filter



area around the venturi is difficult to clean.

Niro has solved this problem in the SANICIP™ filter by the design of the special reverse jet air nozzle (patent pending) positioned above each bag (see fig. 2). Compressed air is blown into the bag through this nozzle. A jet is formed which draws air from the clean air plenum into the bag as well, thereby saving compressed air. This is an efficient and sanitary solution. The reverse air jet nozzle has furthermore a dual-purpose during CIP as described below.

The CIP of the bag house is divided into the following main items:

1. The internal bag CIP (patented) cleans the bag from the inside towards the dirty side (outside). Clean water is injected into the inside of the bag through the reversed jet nozzle and the water is atomized by compressed air. Powder that has penetrated into the bag material

is forced out towards the dirty side by the water spray. No recirculation of water in this step. This feature is extremely important, as it is otherwise difficult, if not impossible, to clean out this entrained powder from the outside only.

2. The clean air plenum CIP cleans the clean air plenum of the bag filter above the hole plate. No recirculation of water in this step.
3. The hole plate CIP cleans the bottom side of the hole plate and the snap ring area of the bag using a specially designed nozzle, also with a dual-purpose: During the process the nozzle is purged with compressed air to keep the hole plate free of deposits and thereby avoid discolouring/denaturation. The water is recirculated.
4. The shell CIP is performed by means of Niro standard retractable CIP nozzles. The water is recirculated.

The CIP is divided into the following sequences:

1. Pre-rinse #1, using a minimum of water for initial rinse. Water is not reused. The solid content

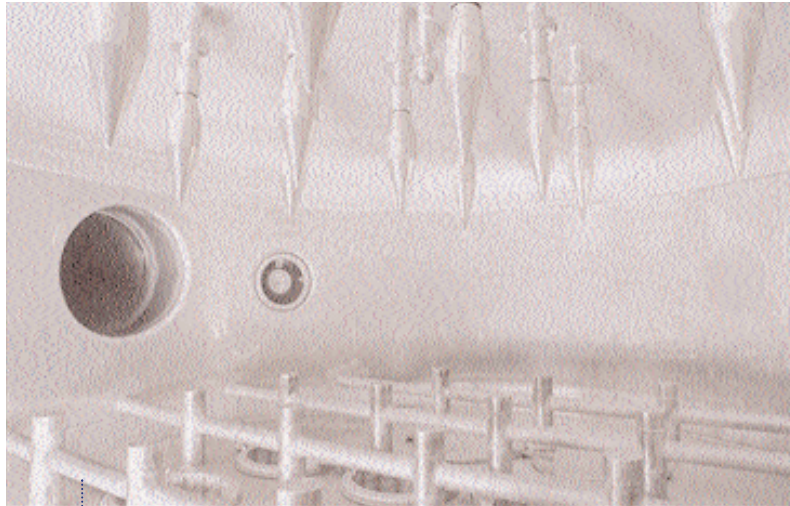


Fig. 2: Clean air plenum with reverse jet air nozzles (patent pending).

- in the wash water is high, so recovery is possible, and the load on the waste water system is minimized.
2. Pre-rinse #2, water is recirculated below the hole plate, then to drain.
3. Caustic wash, using both the internal and external systems. Bags are alternatively washed from the inside and the outside.
4. Middle rinse.
5. Acid wash, using both the internal and external systems. Bags are alternatively washed from the inside and the outside.
6. Final rinse, using internal and external systems with clean water.

The CIP is followed by bag drying. Estimated 6 to 10 hours for complete CIP and dry out.

Advantages of the SANICIP™ Filter:

- ♦ Low pressure loss across the bag filter and thus the entire exhaust system, i.e. reduced energy consumption and noise emission.
- ♦ Designed for optimum air-to-cloth ratio and powder load (due to one bag being blown at the time)
- ♦ Higher yield of raw materials due to no second grade products

Table 1: Comparison of powder separators

	Cyclone	Cyclone + bag filter	Cyclone + wet scrubber	SANICIP™
Emission	20-400 mg/Nm ³	5-20 mg/Nm ³	max. 20 mg/Nm ³	5-20 mg/Nm ³
Pressure loss	280 mm WG	340 mm WG	340 mm WG	170 mm WG
Exhaust system (incl. ducts, etc.)				
Auxiliaries	none	compressed air	liquid circulating system	compressed air
Cleaning	suitable for CIP	difficult	suitable for CIP	suitable for CIP
Hygroscopic products	insensitive	sensitive	insensitive	insensitive
Use of separated product	first grade	first and second grade	not recommended	first grade
Maintenance	minimal	service of compressed air system and change of bags	minimal	service of compressed air system and change of bags
Sanitary conditions	good	relatively good	less good	good

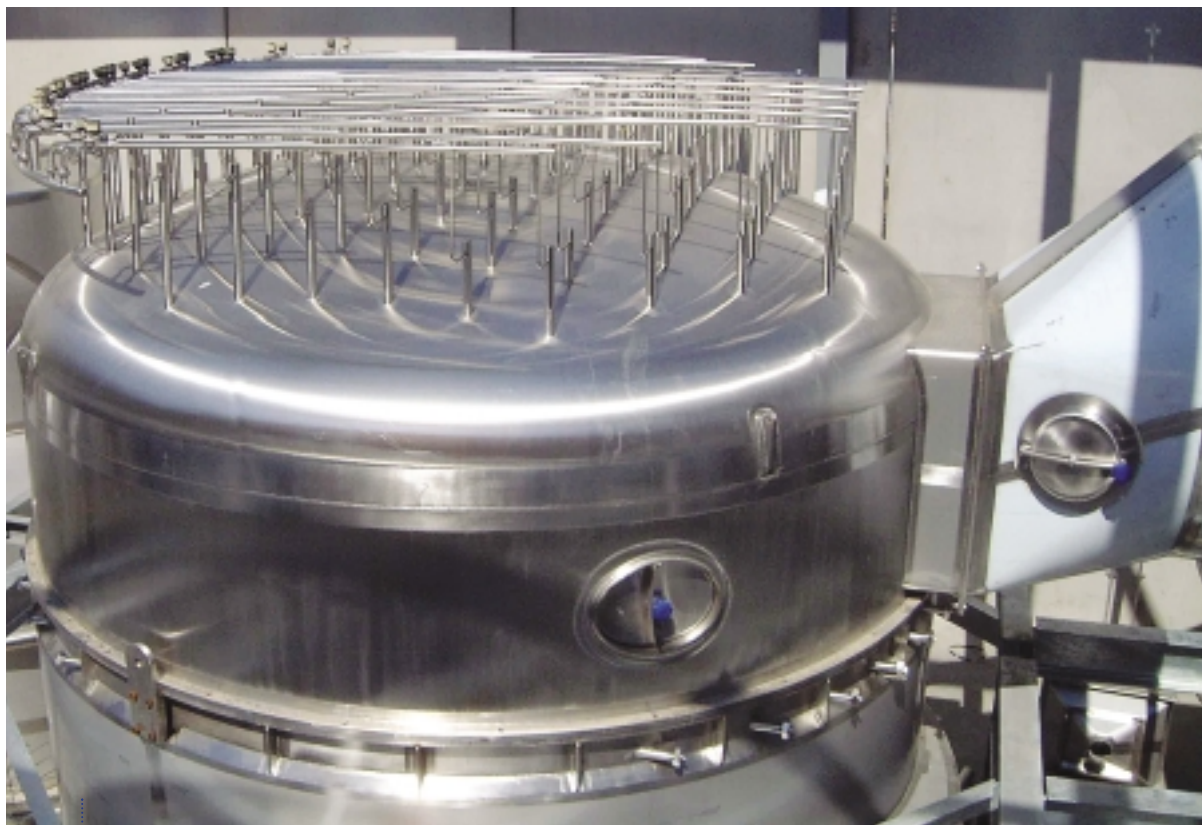


Fig. 3: Top part of SANICIP™ bag filter outlet chamber with internal bag CIP piping.

- ◆ Design with 4 or 6m bags to suit specific building requirements
- ◆ Reduced space requirements for new installations
- ◆ Easy replacement of cyclones for retrofits without major building changes
- ◆ USDA 3A acceptance (pending)
- ◆ Short dry-out time, compared with other CIP-able bag filters.

Products

The products that have been tested in our pilot plant or are produced in industrial plants equipped with the SANICIP™ filter are many and

range from high protein WPC products to high fat and carbohydrate products incl. whey, permeate and coffee-whitener products.

Conclusion

The SANICIP™ bag filter provides the users with a unique solution to solve environmental problems in an economical way, whether in new plants or in connection with upgrading of existing installations. The advantages are many as described above. For special products test facilities are available in our pilot plant laboratory. ■

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Fig. 4: JET CIP using the reverse jet air nozzle.

ECONOMY

In order to illustrate the economical benefit of the SANICIP™ bag filter, compared to traditional cyclones/bag filter solutions, the following basis for the example is used:

Cyclone loss:	250 mg/Nm ³ of air
Bag filter loss:	10 mg/Nm ³
Cost of energy:	0.15 USD/kWh
Process gas rate through exhaust system:	50,000 Nm ³ /h
(corr. to approx. 2,000 kg/h powder)	
Operating time per year:	7,000 hours
Price of product, 1st grade:	USD 2,000/ton
Price of product, 2nd grade:	USD 500/ton

Compressed air consumption and bag change requirements are considered the same for traditional bag filters as for the SANICIP™, therefore no influence on the economical advantages.

Example:

Additional product recovery	
50,000 Nm ³ /h x (250-10) mg/Nm ³ =	12 kg/h
7,000 h/year x 12 kg/h =	84 tons/year
84 tons/year x (2,000-500 USD) =	126,000 USD/year
Savings in power consumption:	
50,000 x (340-170) / 3600 x 102 x 0.75 =	30 kW
7000 h/year x 30 kW =	210,000 kWh
210,000 kWh x 0.15 USD/kWh =	31,500 USD/year
Corresp. to an annual saving of more than	USD 150,000.-

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