TECHNICAL INFORMATION
March 2007

WET CLEANING OF ROTARY VALVES AND DIVERTER VALVES

> CLEANING OUT OF PLACE (COP) <
> CLEANING IN PLACE (CIP) <

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Rotary valves and diverter valves for applications in the food, pharmaceutical and chemical industries which meet hygiene requirements and are suitable for wet cleaning.

Extremely stringent hygiene and purity requirements are very important in many fields in the food, pharmaceutical and chemical industries.

It is often necessary to wash and inspect production systems regularly in order to meet increasingly stricter specifications and remain competitive.
Wet cleaning is recommended when the product is perishable or products are changed frequently. Stricter specifications which must be met by the end product (such as non-allergenic or gluten-free) also make many system operators decide to introduce wet cleaning of components to prevent contamination of the end product.

Milk powder and baby food are typical examples of products for which dry cleaning is often no longer sufficient. The inside of hoppers, conveying pipes and bulk material components are alternately cleaned according to a specified procedure with cleaning media, such as weak acids or lyes, and water. It is also important to design all products in a production process to meet hygiene requirements and withstand the cleaning media.

There are two different cleaning methods:

> Cleaning Out Of Place (COP)
> Cleaning In Place (CIP)

Application example:
Wet washed components in a spray drying system for the production of milk powder.

1) Rotary valve downstream from the spraying tower
2) Rotary valve below cyclone
3) Diverter valve, return circuit for fines

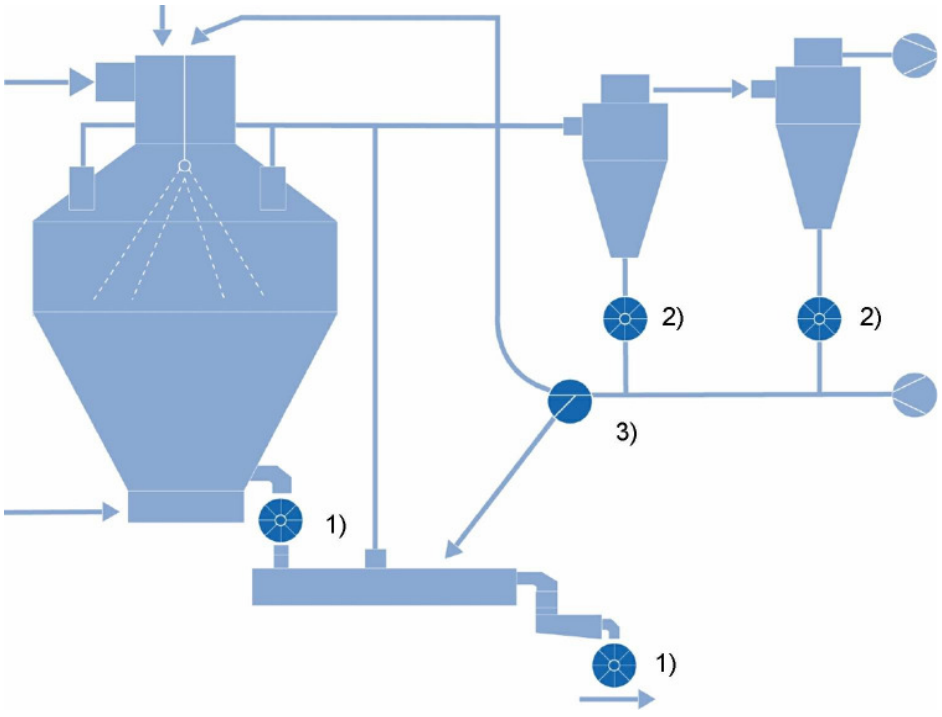

Fig: 1 Spray drying system with bulk material components

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Cleaning Out Of Place (COP)

Definition

Cleaning out of place:
"Cleaning of a component in a dismantled condition when the component has been removed from a system. Subsequent manual cleaning by treating surfaces with chemical solutions, cleaning fluids and rinsing water."

Design of COP components

The components are made completely of stainless steel and ensure resistance to the corresponding cleaning media. Coperion Waeschle generally uses acid-resistant stainless steel 1.4404 (316L) with polished surfaces, surface roughness < 0.8 µm for these applications.
Furthermore the components are designed so that the rotor can be easily dismantled. The smooth surface finish and the avoidance of dead zones minimises product deposits.

Advantages of COP cleaning

Product residues can be easily detected and manually removed. The Coperion Waeschle quick-cleaning versions enable simple inspection and easy cleaning.

Cleaning out of place of rotary valves

There are two options for COP cleaning of rotary valves: Either the valve is washed with the rotor while still installed in the system and the rotor is subsequently dismantled, or the rotor is pulled out before washing.

Fig. 3 Rotor with quick-cleaning coupling

Function / Procedure

With the first method the cleaning medium simply runs through the rotating rotary valve, for example from a tank. The valve gap between the rotor and the housing must be designed for the maximum cleaning temperature. Normally this method achieves good cleaning results.

When the medium has flowed through the valve, however, it must be opened and subsequently cleaned again if necessary (-> "cleaning out of place"). This task is very easily solved by a new development, the FXS (Full Access System) extraction facility , Fig. 2.

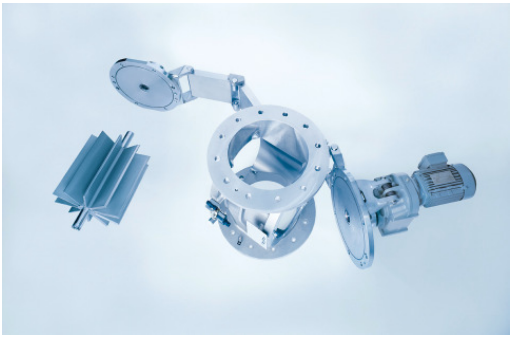


Fig. 2 ZRD rotary valve in COP-version with FXS (Full Access System) extraction facility

The side plate can be quickly released from the housing, pulled out of the housing with the rotor and pushed to one side. To this purpose the rotor is equipped with a quick-cleaning coupling which permits fast separation from the endplate and simple re-fitting of the rotor (Fig. 3).

The second method for COP wet cleaning is to pull the rotor out before cleaning. In this case the open housing bore is closed with a cleaning plate, a "dummy", and the cleaning medium runs through the "rotor-less" valve housing (Fig. 4). This method is suitable if the rotor has to be cleaned separately, for example in a cleaning system, to remove stubborn caked deposits.

Advantages of the Coperion Waeschle technology

The optimum feature of both methods is that both side plates of the valve can be opened and pushed to one side (Fig. 2). This is the only effective way to ensure full cleaning, also on the connecting surfaces between the housing and the side plate, and also to prevent liquid remaining trapped in the joint.

The FXS swivel extraction facility also ensures maximum accessibility and ensures complete cleaning.

Fig. 4 Cleaning side plate for COP application

Cleaning out of place of diverter valves

Diverter valves are often made of aluminium to lower weight and costs, and the pipes in contact with the product are often made of stainless steel. However, this material combination is not adequate for wet cleaning. The aluminium is corroded by the cleaning media and in the long term the diverter valve is destroyed. For this reason diverter valves made of full stainless steel are used in such cases.

Function / Procedure

Fig. 5 shows the WYK stainless steel diverter valve in a COP version. The rotor actuator turns the rotor from outlet to outlet depending on the conveying path selected for pneumatic conveying (Fig. 6).

There are also two possible methods for cleaning the diverter valve as for the rotary valve: Either the rotor remains in the housing during cleaning or it is previously dismantled.

In the first case the diverter valve is designed for the normal pressure of the cleaning fluid during the cleaning procedure. This is within a range of up to +5 bar(g). The rotor can be switched over during washing.

With the second method the rotor is manually pulled out of the housing before cleaning (Fig. 7). The housing is sealed during cleaning with a cleaning plate (Fig. 8), the rotor can be separately cleaned by hand.

Fig. 5 *Stainless steel diverter valve type WYK for COP cleaning*

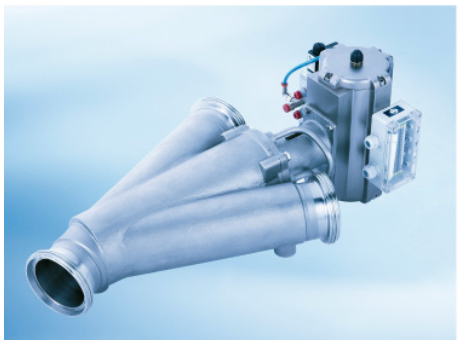


Fig. 7 *Stainless steel diverter valve type WYK for COP cleaning, dismantled*

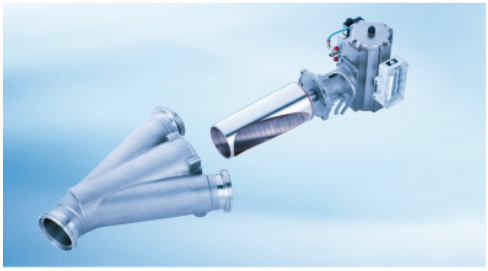


Fig. 6 *Principle of operation WYK*

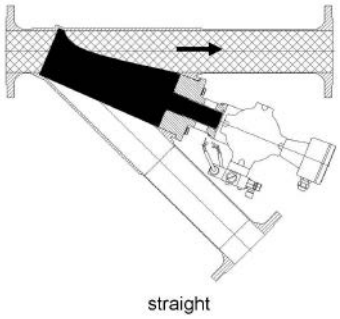
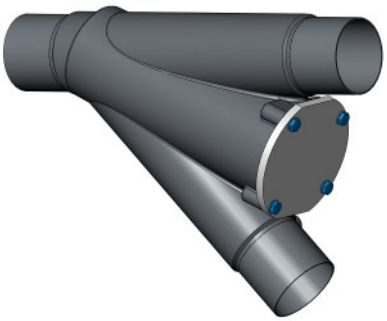
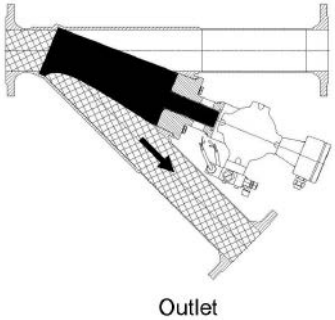


Fig. 8 *Cleaning plate for WYK-COP*





Advantages of the Coperion Waeschle technology

The WYK-COP diverter features both a simple principle of operation and a compact design, and also has exact pipe diameters without any change in cross-section.

The actuator plate can be released with only four screws and the rotor is easily pulled out of the housing. Even if caking products are conveyed, the tapered design of the rotor ensures trouble-free extraction.

Cleaning in place (CIP)

Definition

Cleaning in place as stipulated by ISO 14159: *"Cleaning in place. Cleaning without dismantling of equipment or systems designed to this purpose by treatment of the surfaces with chemical solutions, cleaning fluids and rinsing water and circulation within the system."*

Design of CIP equipment

If the CIP principle is adhered to completely, equipment must be designed so that it is completely clean and germ-free after automatic cleaning, without additional dismantling and subsequent manual cleaning. This means that there should not be any gaps or dead zones in which the product or cleaning fluid can collect.

Advantages of CIP cleaning

Fully automatic cleaning saves time and money. It is not necessary to constantly dismantle and manually clean the components. CIP cleaning is particularly advantageous for components which are difficult to access.

Cleaning in place (CIP) of rotary valves

With the ZRD-CIP Coperion Waeschle has developed a rotary valve especially for CIP applications.

Function / Procedure
The rotor remains installed during CIP cleaning. It rotates and therefore transports the washing water further.

Technical details (Figs. 9/10)
> Rotor and housing
Surfaces and geometry are designed so that optimum flow and therefore the best possible cleaning results are achieved.

> Inlet/outlet flange
The FDA compliant contour seals were developed especially for this application. With the corresponding counterflange the seals are pressed together so that they are flush with the product chamber. Gaps and dead zones are therefore prevented.

> Side plate seal
The special side plate is adapted to the form of the housing so that there are no sharp edges. The FDA compliant side plate seal is also flush.

> Shaft seal
The special side plate with the FDA compliant shaft seals and pre-positioned CIP ring prevents product and cleaning media penetrating into the seal. In addition the seal is purged with air during valve operation and during cleaning.

> Quick-cleaning and extraction facility Although this is not essential, the CIP valve is equipped in the same manner as the COP valve with a quick-cleaning facility and an optional swivel extraction device (Fig. 2). This enables simple periodical inspection.

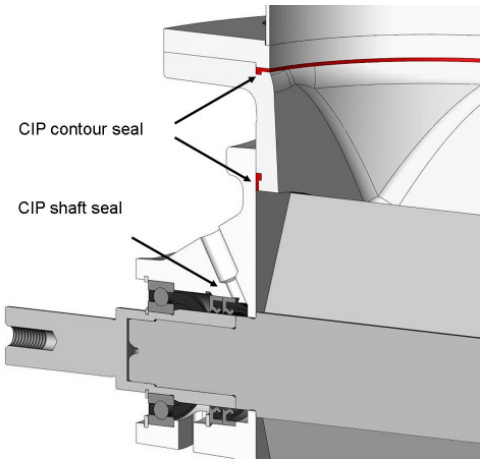


Fig. 10 Rotary valve in CIP-version

Fig. 9 Side plate seal CIP version

EHEDG certification

The complete cleanliness of the rotary valve ZRD-CIP after CIP cleaning was confirmed by a test run in accordance with EHEDG procedures at the University of Weihenstephan/Munich in March 2007.

To this purpose the rotary valve was contaminated with milk spores which were subsequently dried. CIP cleaning was performed in the prescribed manner (Fig. 11).

Fig. 11 EHEDG CIP test of the Coperion Waeschle rotary valve

In order to evaluate how clean the valve is in comparison to a standard reference pipe, the rotary valve was filled with agar, a special bacterial culture medium, and incubated at 58°C for approximately 20 hours (Fig. 12).

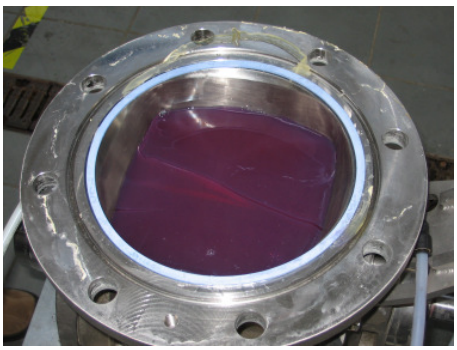


Fig. 12 Filling with Agar

The culture medium was then pushed out of the rotary valve and examined on an illuminated table (Fig. 13). As there was no change in colour, this indicated the absence of any germs or bacteria after CIP cleaning. The test series was performed several times with positive results, and the valve was cleaned thoroughly by the procedure. The EHEDG certified the ZRD-CIP for fully automatic wet cleaning.

Fig. 13 Examination on the illuminated tabel – no colour changes

Advantages of the Coperion Waeschle technology

The ZRD-CIP rotary valve is the only rotary valve certified by the EHEDG which can be used for fully automatic CIP cleaning and which does not endanger the production process. This means considerable savings in both time and money for the system owner, as less manual intervention is required.

CERTIFIED HYGIENIC ENGINEERING & DESIGN GROUP EUROPEAN EHEDG TYPE EL MARCH 2007

Cleaning in place (CIP) of diverter valves

CIP-compatible diverter valves are of particular interest, as in contrast to the rotary valves the diverter valves are often installed at positions which are not easily accessible, and manual cleaning is very complicated. Coperion Waeschle offers the newly developed WYK –CIP for this application (Fig. 14)

Fig. 14 Diverter valve WYK-CIP

Function / Procedure

A particularly innovative design for which a patent application has been submitted enables both pneumatic conveying and also fully automatic CIP cleaning:

The conveying path is set to either "straight" or "outlet" with a pneumatic rotor actuator Subsequently during the fully automatic CIP cleaning process with conventional CIP cleaning media the tapered rotor is automatically pulled slightly out of the housing towards the rear with a second pneumatic lifting cylinder.

Due to the conical design of the rotating rotor there is a larger gap between the rotating rotor and housing, and as a result the cleaning medium reaches all surfaces which are in contact with the product, removing all product residues. Purging openings in the actuator plate enable an intense rinsing flow and discharge of the rinsing fluid (Fig. 15).

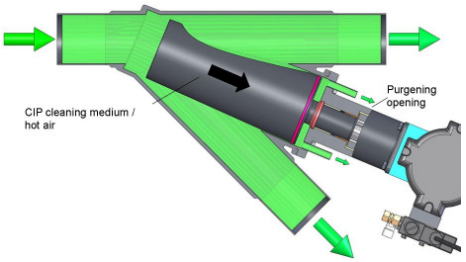


Fig. 15 Function during CIP cleaning

The rotor is subsequently moved back to the normal operating position after cleaning and hot air drying has been completed. The drive unit therefore comprises two elements - a rotor actuator which moves the rotor from one conveying outlet to another, and a lifting cylinder which pulls the rotor axially through the rotor actuator range out of the conveying position (Fig. 16).

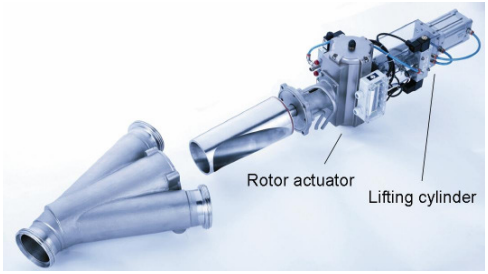


Fig. 16 Diverter valve WYK-CIP, dismantled

Technical details

> Rotor and housing
_for + 5 bar (g) system and differential pressure
_Can be easily dismantled for periodical inspection

> Seal
The outlets are sealed from one another during product conveying by a narrow gap between the rotor and the housing. The diverter valve is sealed towards the exterior by FDA compliant contour seals which were developed for this diverter valve in keeping with the principles of hygienic design of the EHEDG.

EHEDG certification

The WYK-CIP diverter valve was also subjected to a test in accordance with the EHEDG procedures in September 2006 at the University of Weihenstephan/Munich (Fig. 17/18, test procedure see chapter rotary valve)

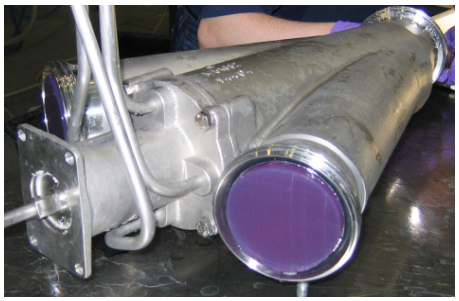


Fig. 17 WYK during EHEDG test

Fig. 18 Diverter valve WYK-CIP, dismantled

The diverter valve also achieved excellent cleaning results after contamination with milk spores and subsequent CIP cleaning. The samples examined on an illuminated table did not show any evidence of colour changes, the design excludes all dead zones to prevent the growth of germs/bacteria. The EHEDG certified the WYK-CIP diverter valve for fully automatic wet cleaning.

Advantages of the Coperion technology

The WYK-CIP diverter valve is the only diverter valve for bulk materials certified by the EHEDG which can be used for fully automatic CIP cleaning and which does not endanger the production process. It saves costly cleaning time and can also be installed at locations which are not easily accessible.

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