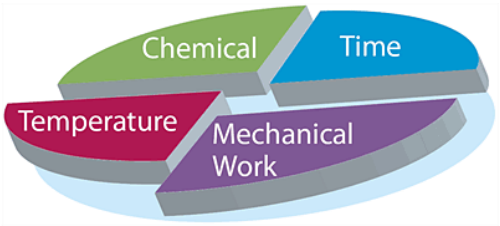


Challenges of powder blending in the food industry: homogeneity, cleaning and hygienic design

Powder Handling and Granular Flow: 24th June 2021

M. Sc. Sebastian Steinkamp

Rhys Morris

AGENDA

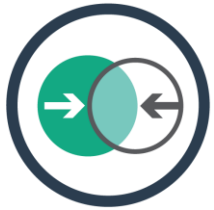
- Brief overview of Lodige
- Cleaning Challenges in Food Industry
- Dry Cleaning (Excursus)
- Terms of Wet Cleaning Systems
- WIP-Process in horizontal Ploughshare® Mixers
- Test Methods for Determining the Cleaning Efficiency
  - Riboflavin Test
  - Swab Test
  - Direct Contact Test (DCT)
  - Rinse Test

Located in Paderborn/Germany since 1938
with approx. 440 employees and
68 Mio. EUR turnover accross the group

Business Activities

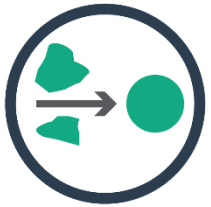
Mixing

Drying



Reacting

Coating



Granulating

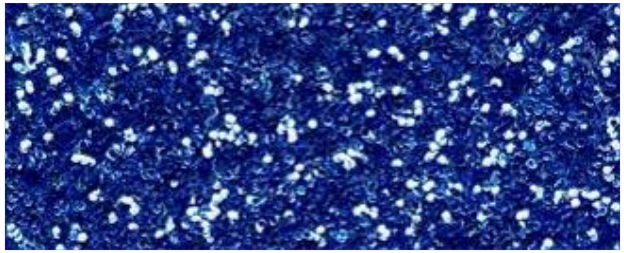
Turnkey Solutions

Raw Materials

Bulk Solids

Powder

Paste



Granules

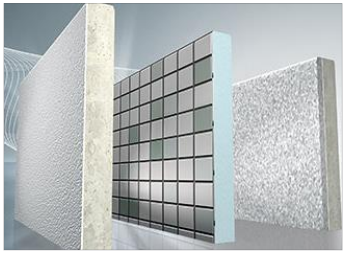
Dust

Sludge

Industries

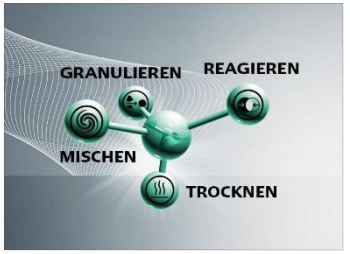
Chemical Industry

Pharmaceuticals



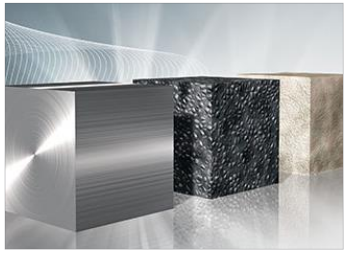
Building Materials

Plastics



Polysaccharides

Food



Minerals / Ores

Environment

Cosmetics

Cleaning Challenges in Food Industry

Cleaning Challenges in Baking & Confectionery Industry

LIFE SCIENCE TECHNOLOGY

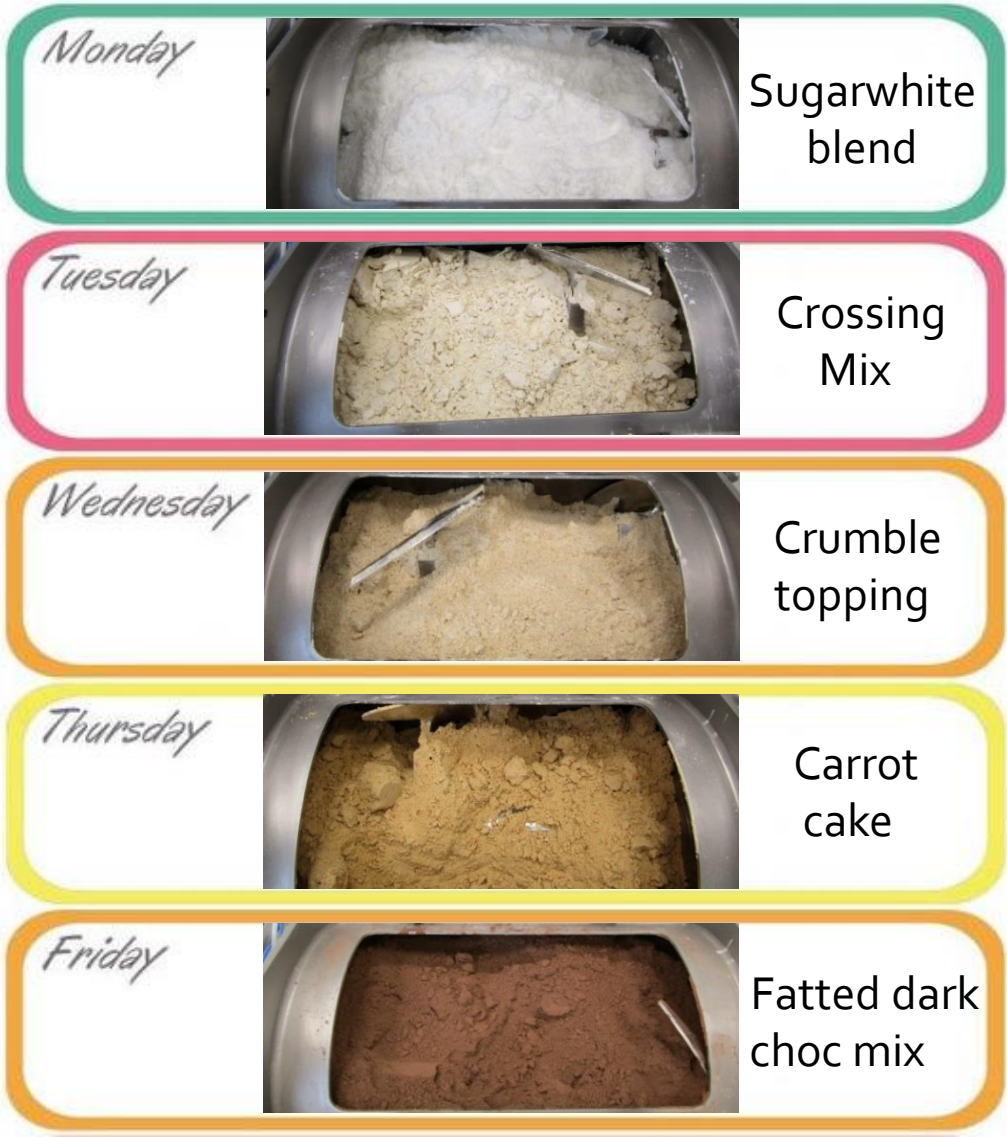
- Baby nutrition
- Baking mixes
- Vanilla sugar
- Chocolate
- Ice cream powder
- Enzymes
- Vitamin preparation
- Dietary food
- Nutritional supplements
- Etc.....





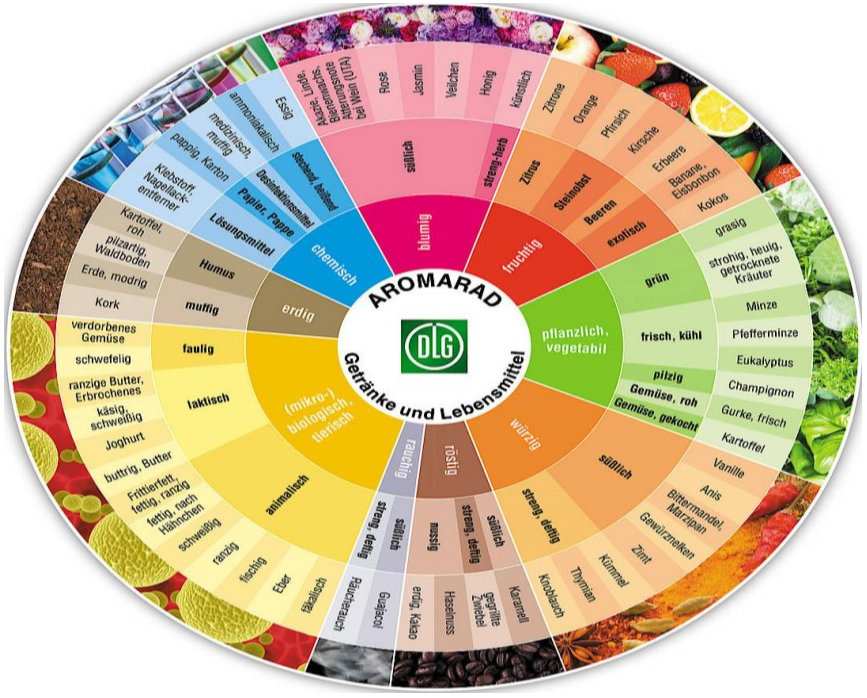

Cleaning Challenges in Baking & Confectionery Industry

- Product line of > 4.500 recipes
- Based on > 3.000 raw materials
- Partially 50 - 55 different dry ingredients (range 0,001 - 45 %)
- Plus 1 - 15 % liquid fraction
- Result:
  - Cleaning is mandatory to avoid any cross contamination
  - Cleaning takes a large part of potential production time



Cleaning Challenges in Baking & Confectionery Industry

CONTAMINATION OF FOOD



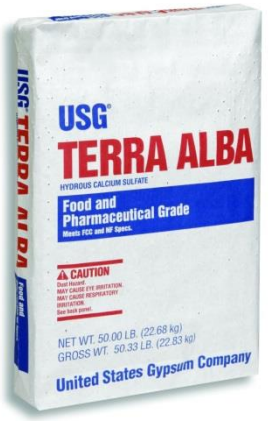
Sensory and Microbiology

14 major allergens

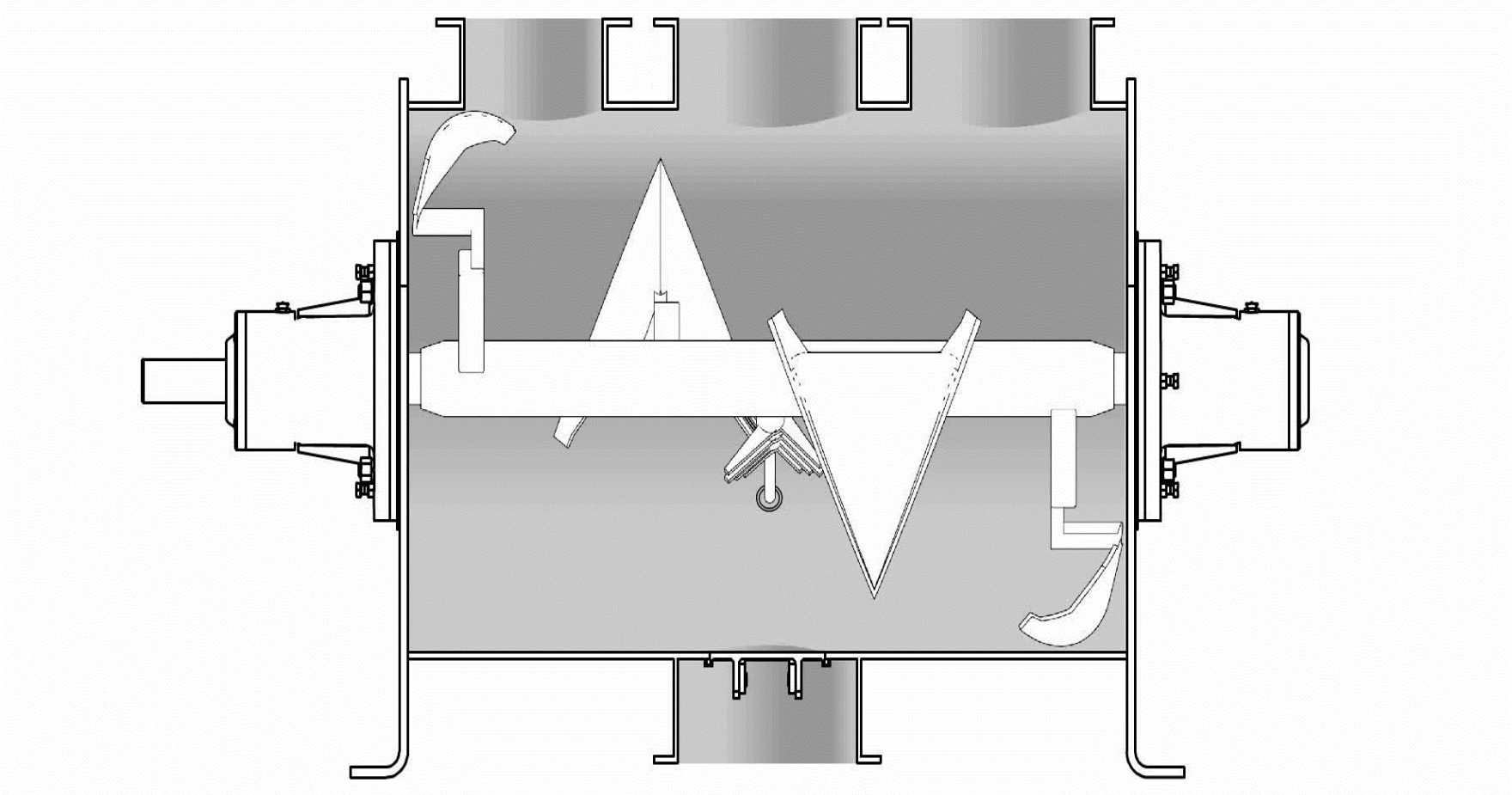
Dry Cleaning (Excursus)

Dry Cleaning (Excursus)

- Wet cleaning followed by drying is the safest method to minimize cross-contamination in any form.
- However, it is also the most expensive and time-consuming method.
- Dry cleaning is the fastest method but with the highest risk of cross-contamination.
- Here the system must be designed in such a way that residues are easy and can be removed quickly.
- The "extended" dry cleaning offers the possibility to save 50% (depending on the mixer type) time and as far as possible exclude "cross-contamination".

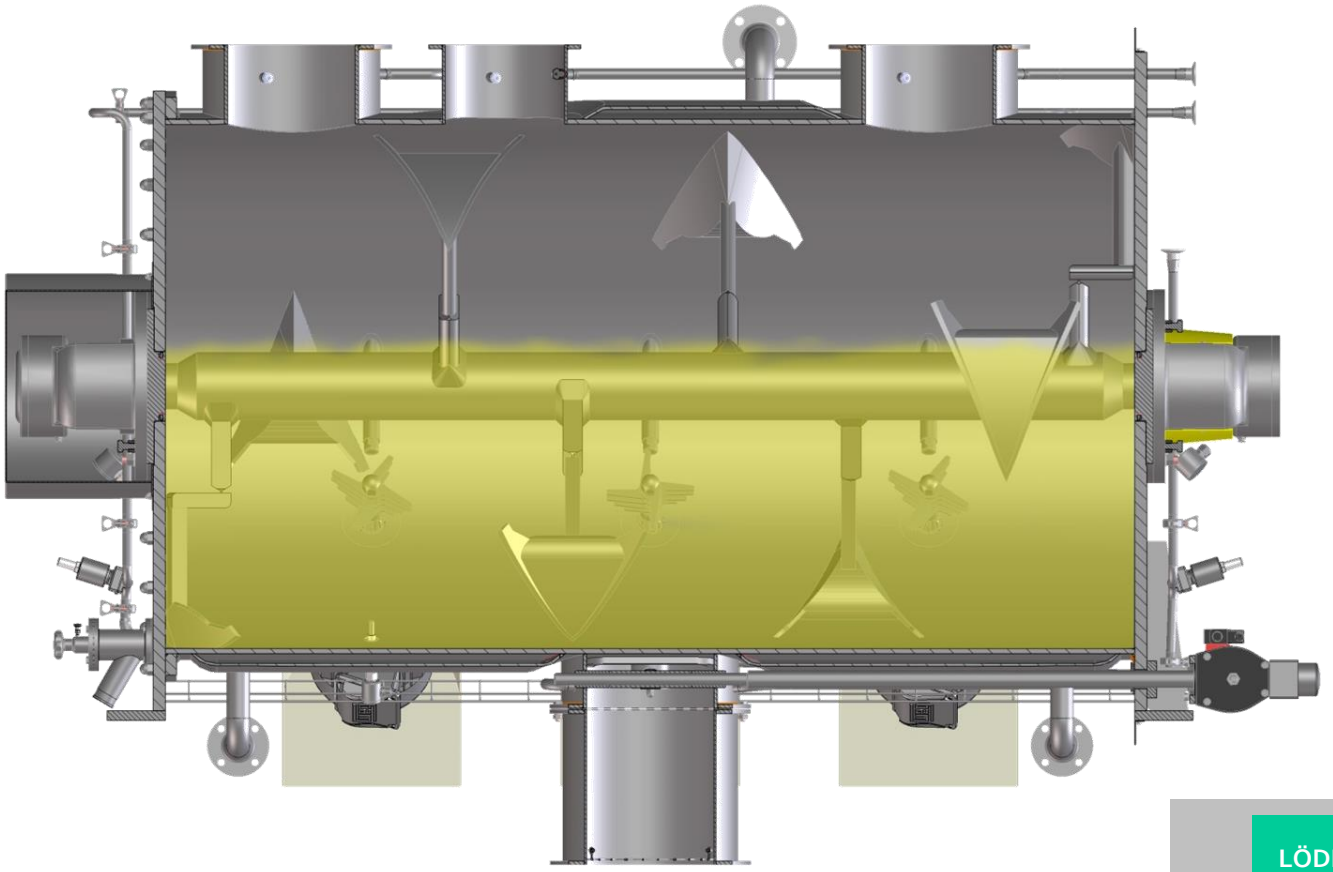


Dry Cleaning (Excursus)



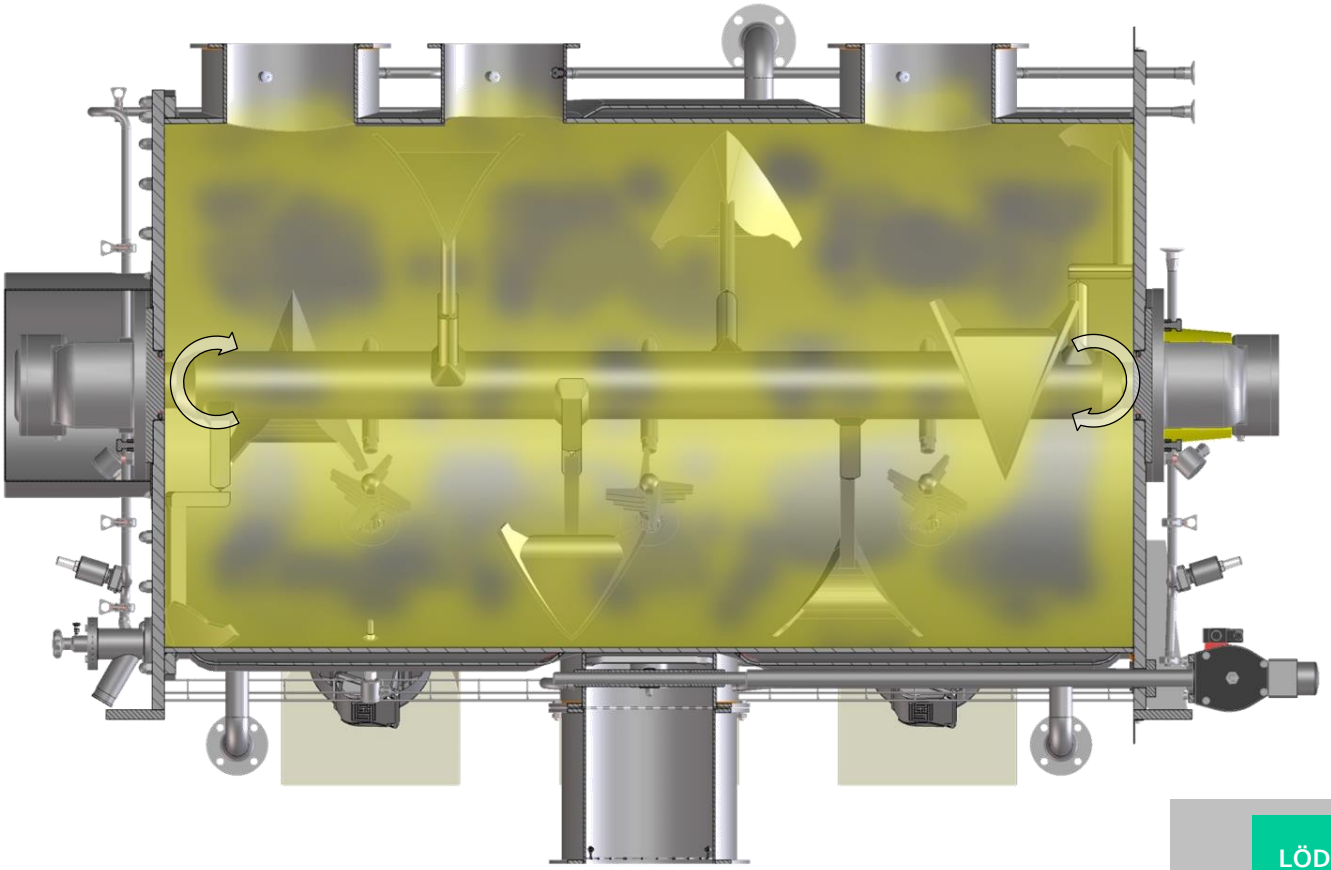
Dry Cleaning (Excursus)

Step 1: Mixer filled with sticky powdered ingredients.



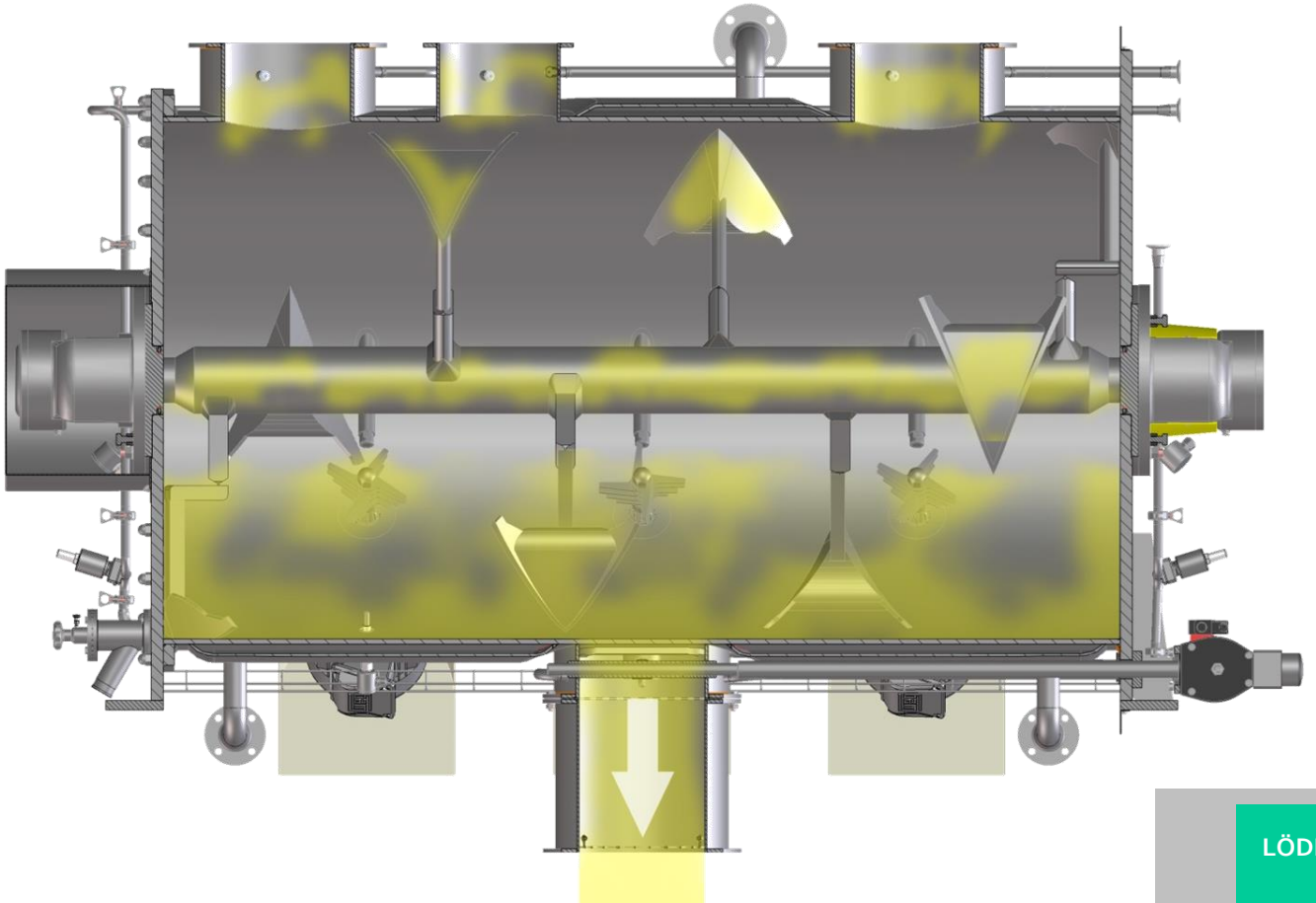
Dry Cleaning (Excursus)

Step 2: Mixing the product.



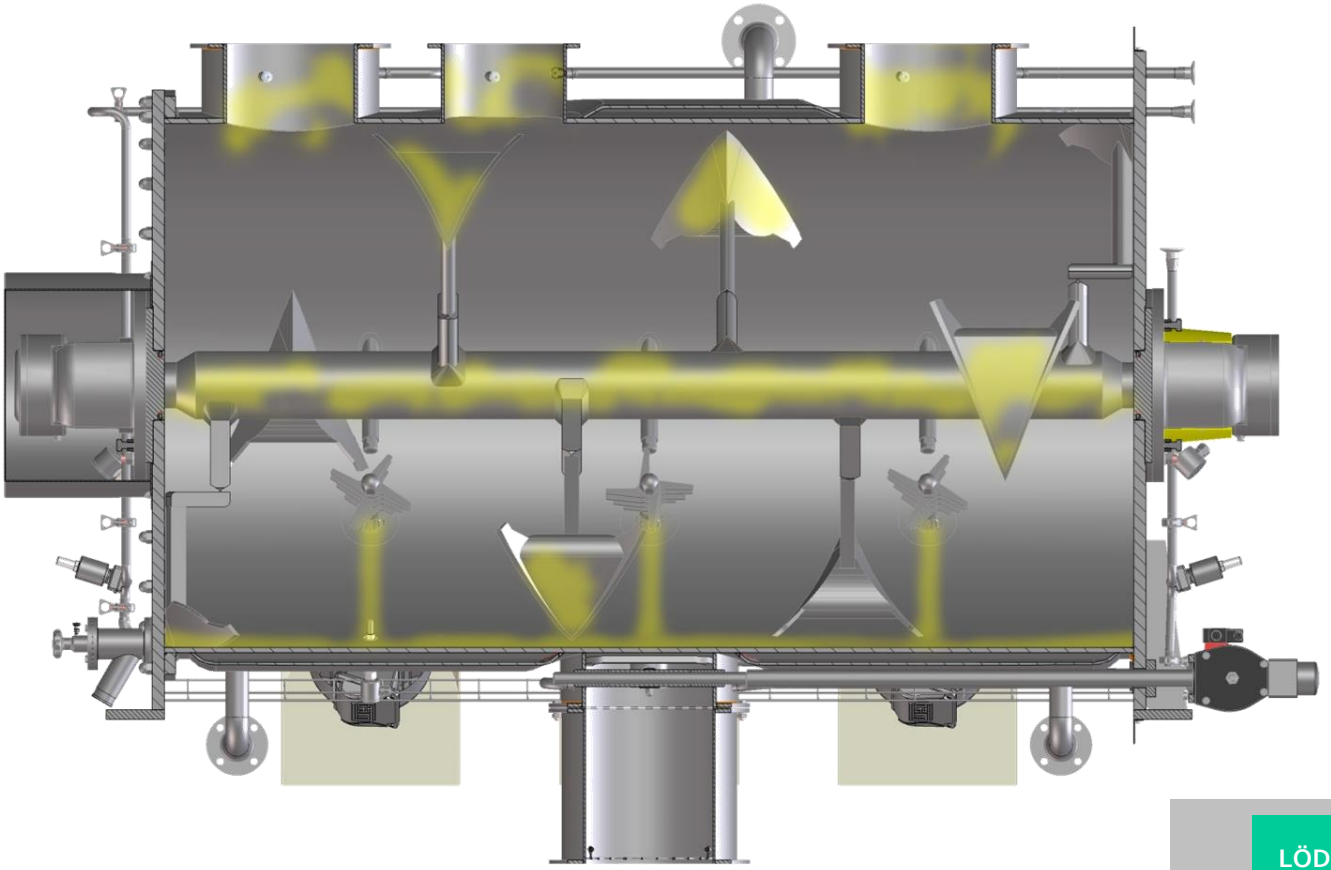
Dry Cleaning (Excursus)

Step 3: Discharging the well mixed product.



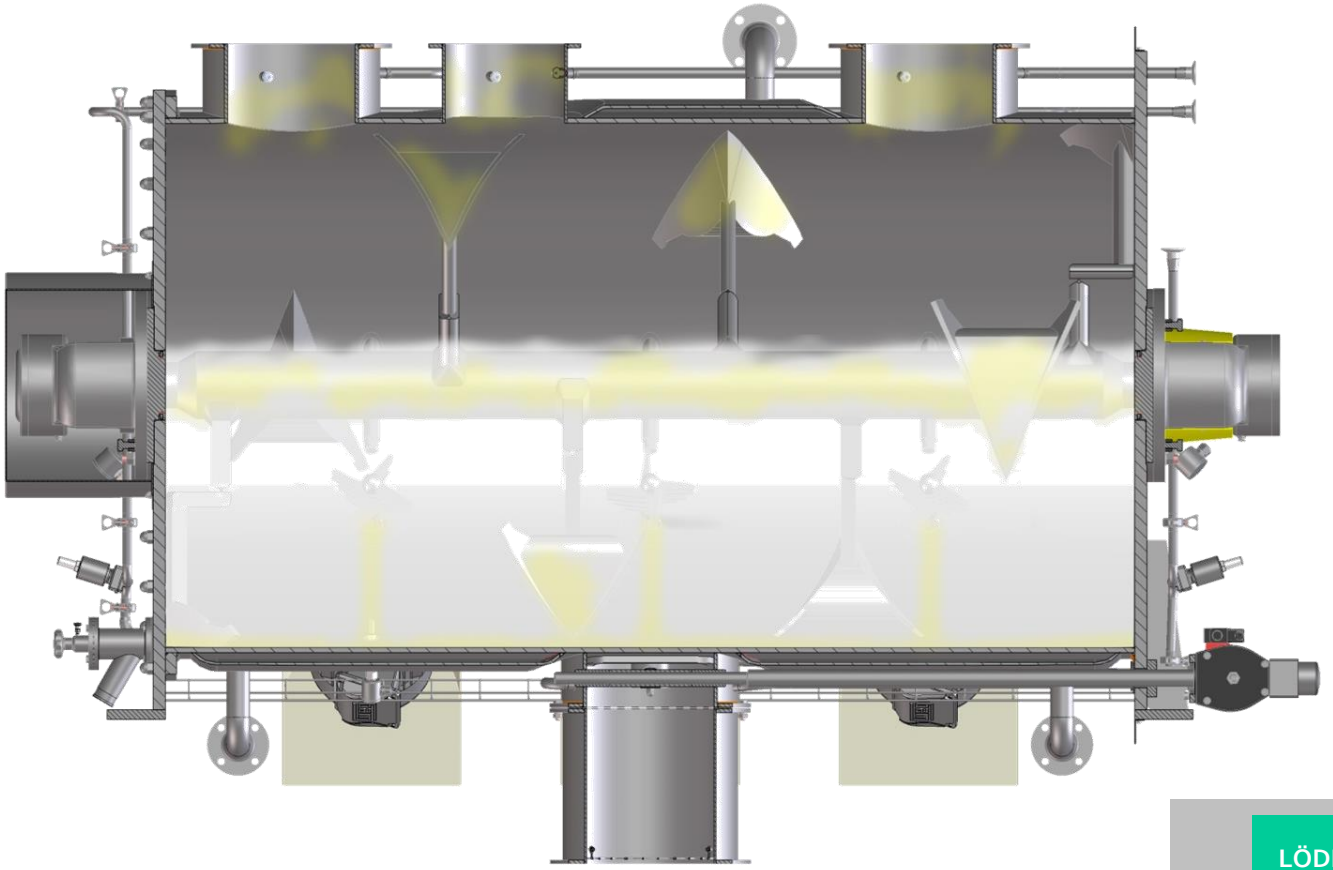
Dry Cleaning (Excursus)

Step 4: Residue of sticky powder in the mixing drum.



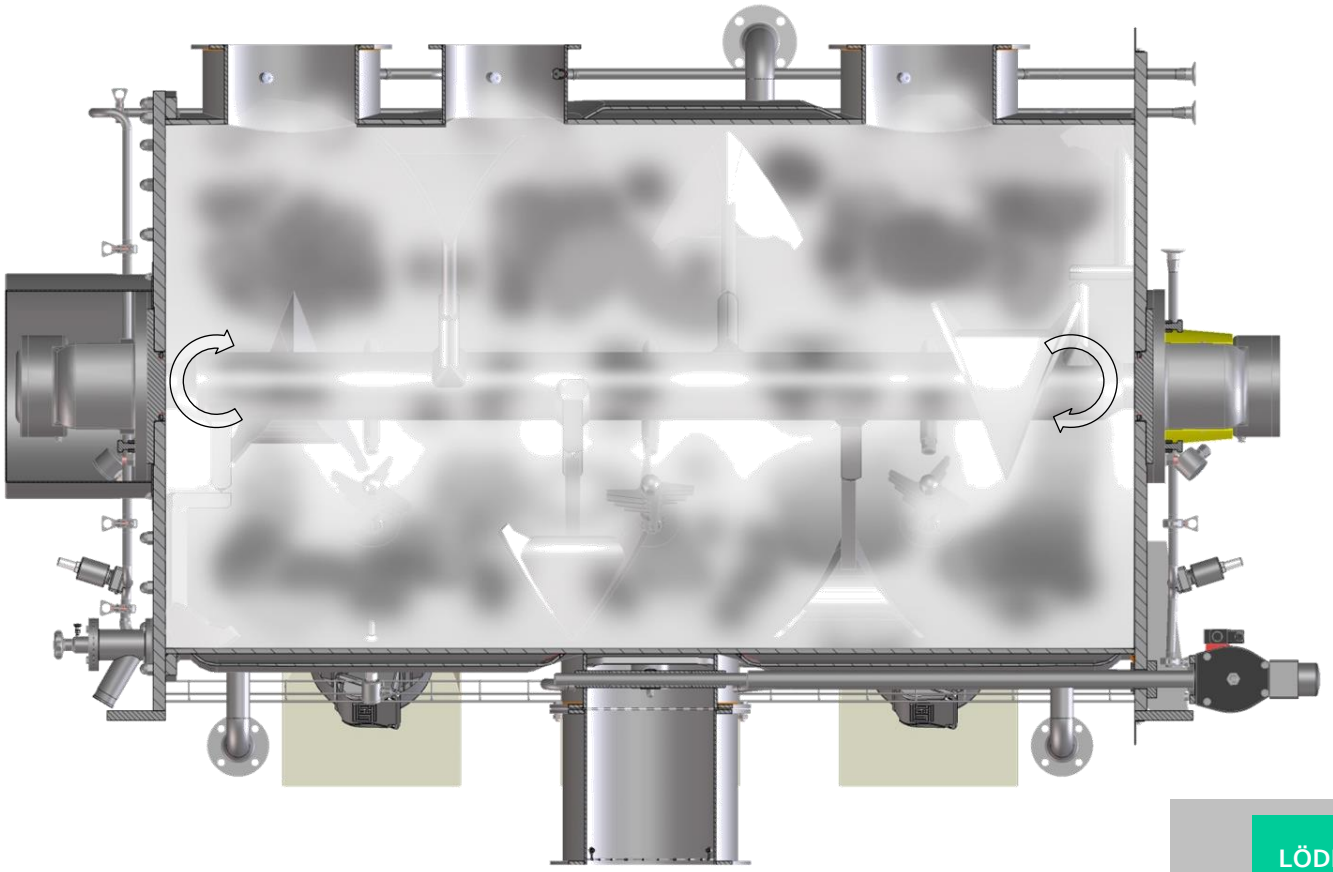
Dry Cleaning (Excursus)

Step 5: Filling the mixer with dry cleaning agent.



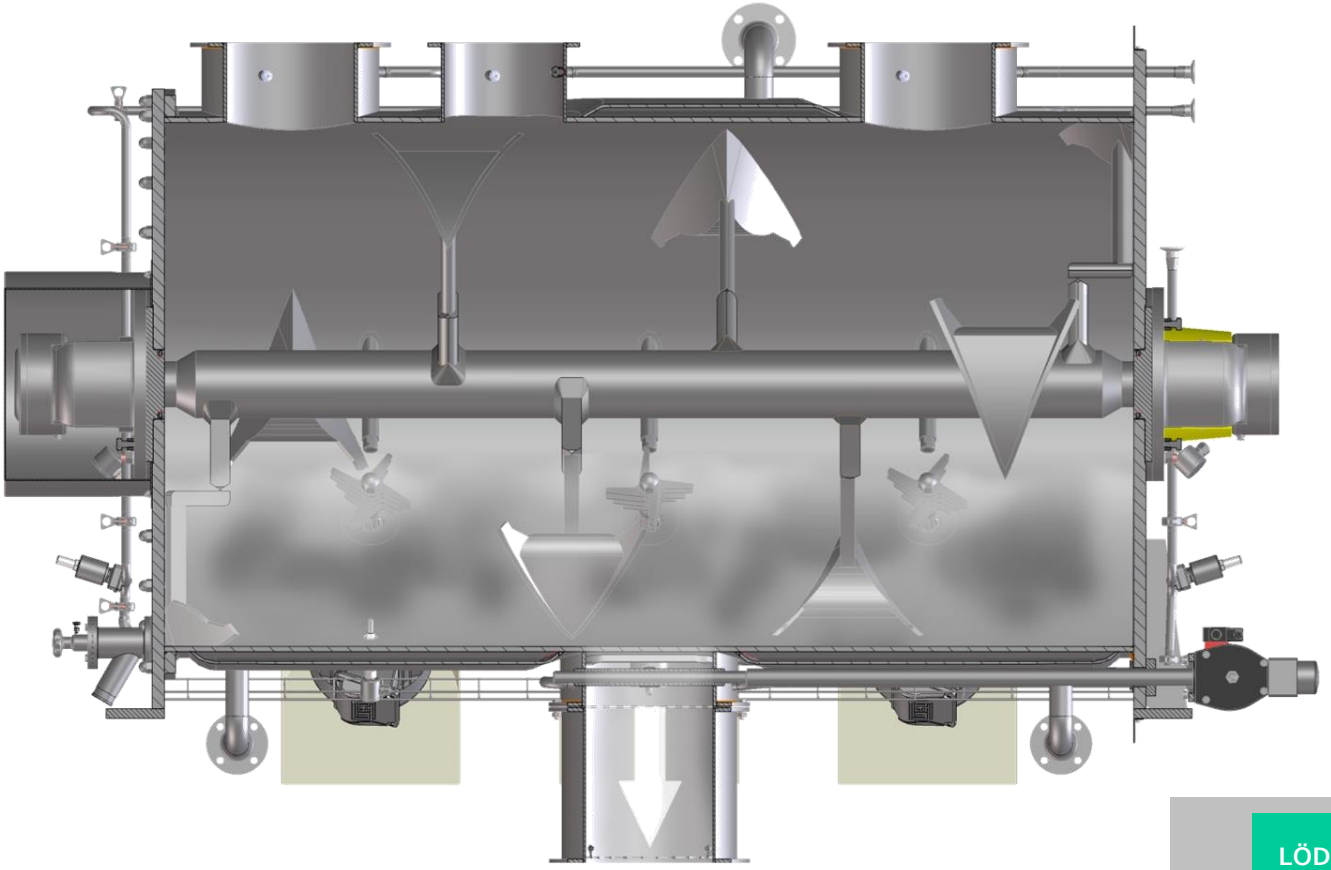
Dry Cleaning (Excursus)

Step 6: Move the mixing tools with max. RPM.



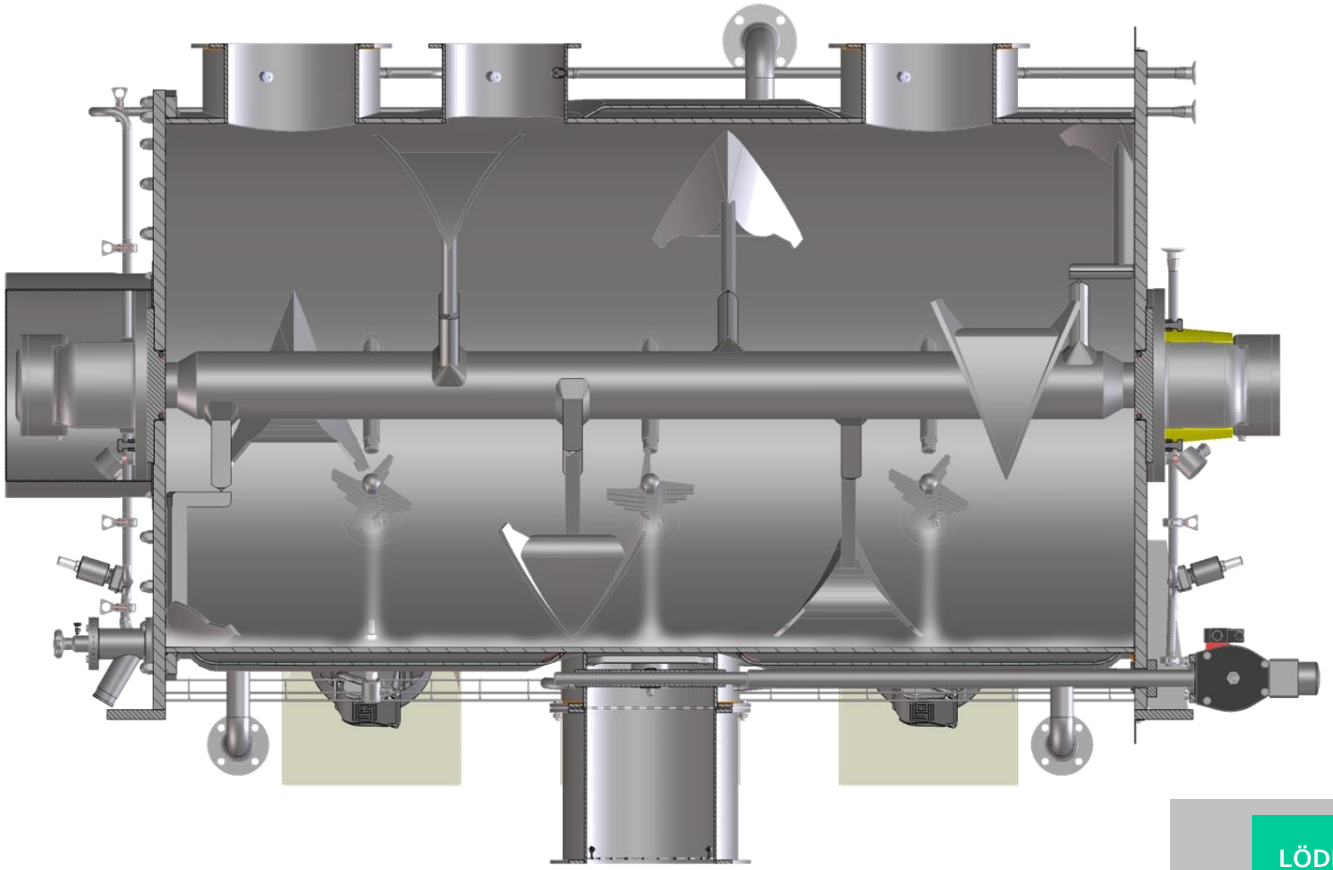
Dry Cleaning (Excursus)

Step 7: Discharge the dry cleaning agent.



Dry Cleaning (Excursus)

Step 8: Residue after dry cleaning.

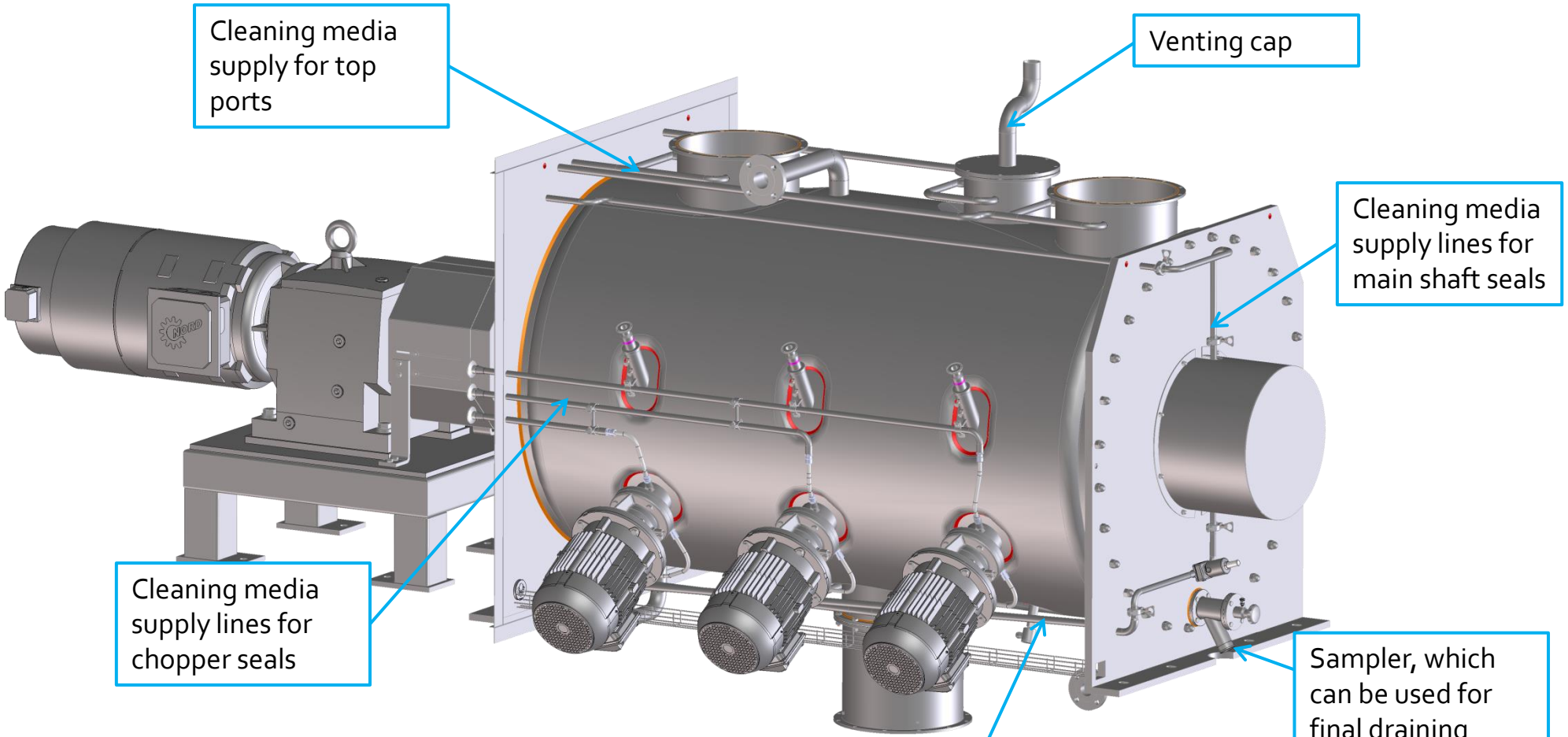


WIP-Process in Ploughshare® Mixers

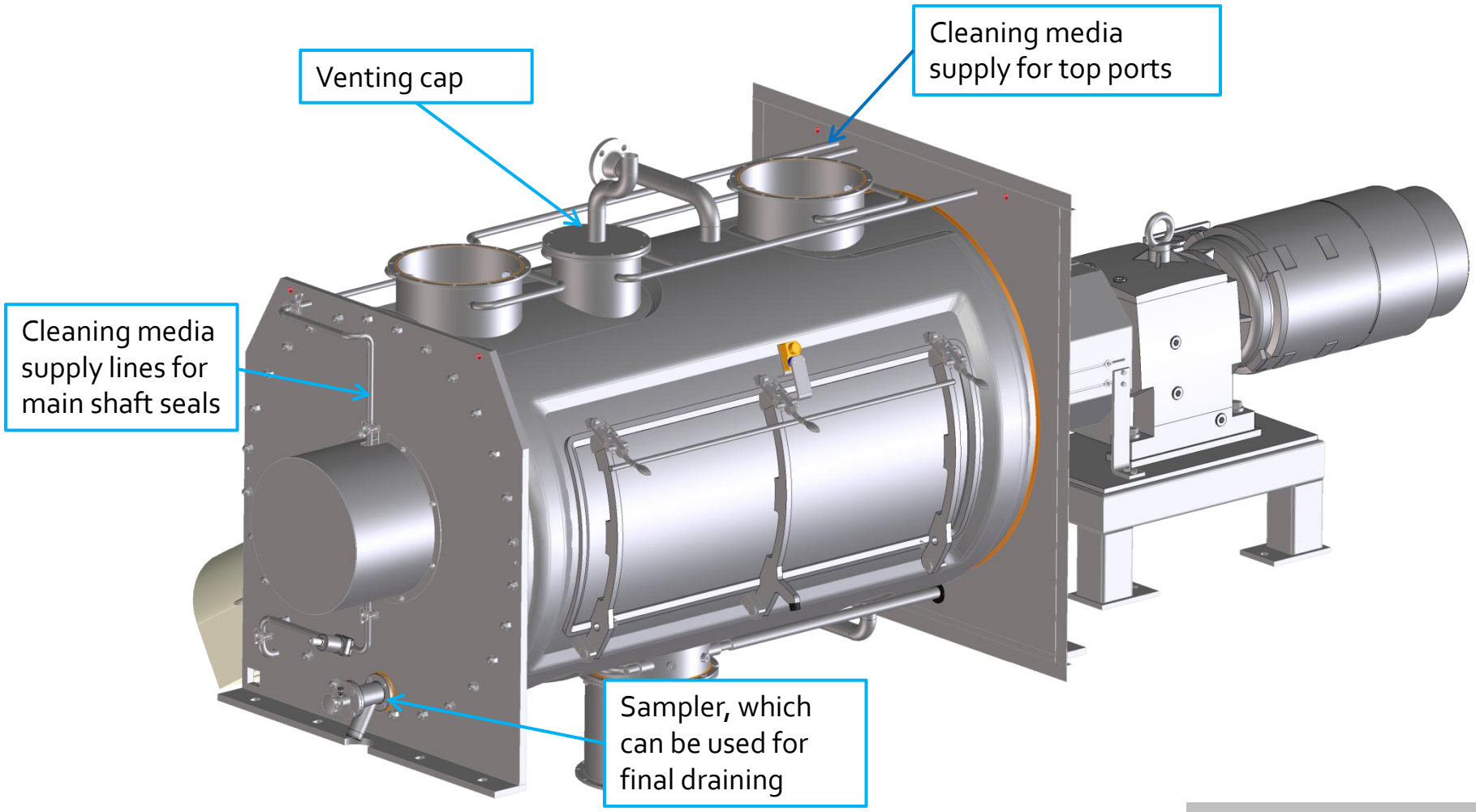
Terms of Wet Cleaning Systems

- WIP (Wash In Place) → machine is equipped with an automatic cleaning system but certain actions have to be done manually (e.g. connection of washing lids or hoses, dismounting of filters, etc.).
- CIP (Clean In Place) → machine is equipped with a full automatic cleaning system; there are no manual actions required; after a complete cleaning cycle the machine is ready for operation.
- COP (Clean Out of Place) → machine parts are dismounted and cleaned separately
- SIP (Sterilisation In Place) → after a complete cleaning cycle the machine is sterilized by temperature (steam) or chemical agent.
- DIP (Drying In Place) → after a wet cleaning cycle the machine is dried in place by suitable drying equipment (e.g. coater is dried by its air handling system, VT is dried by using the vacuum unit, etc.).

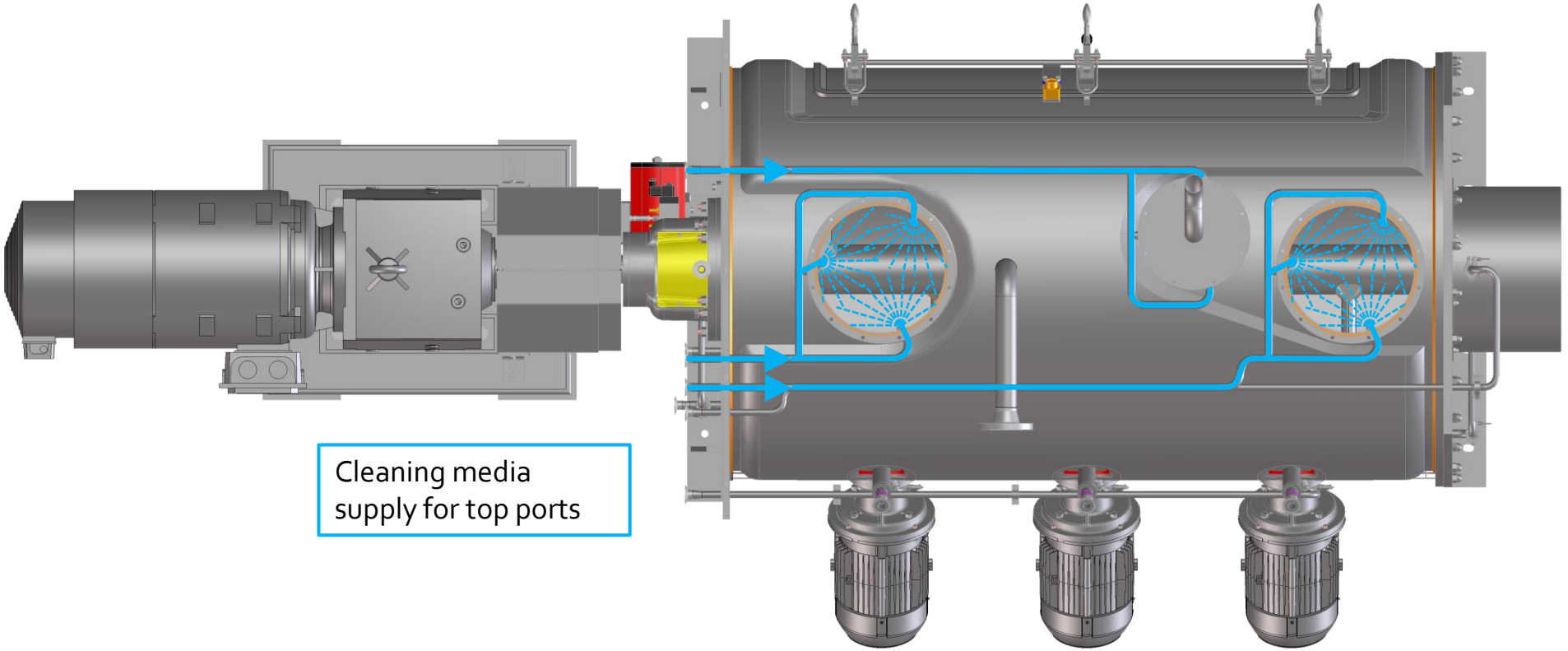
WIP-Design of Ploughshare Mixers



WIP-Design of Ploughshare Mixers

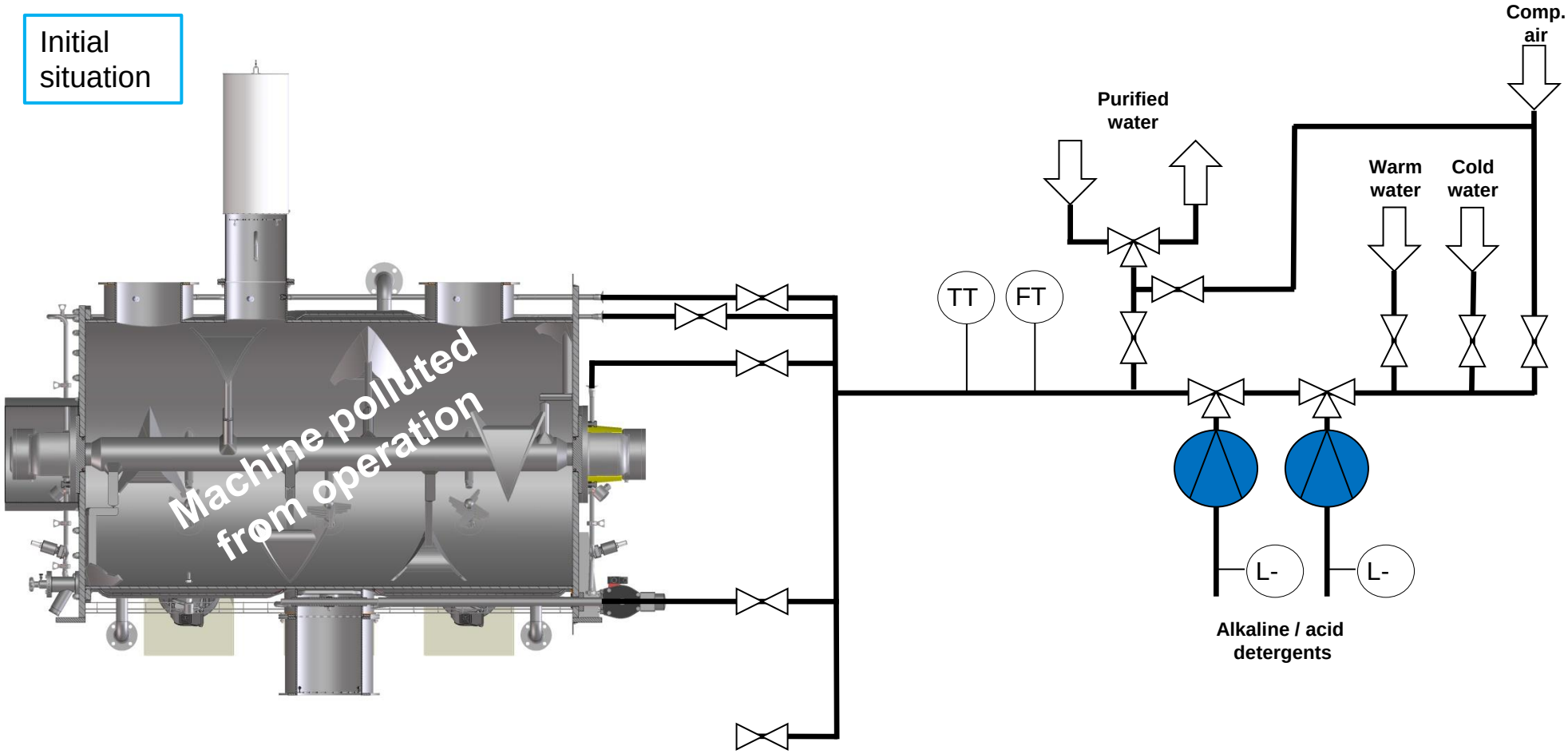


WIP-Design of Ploughshare Mixers



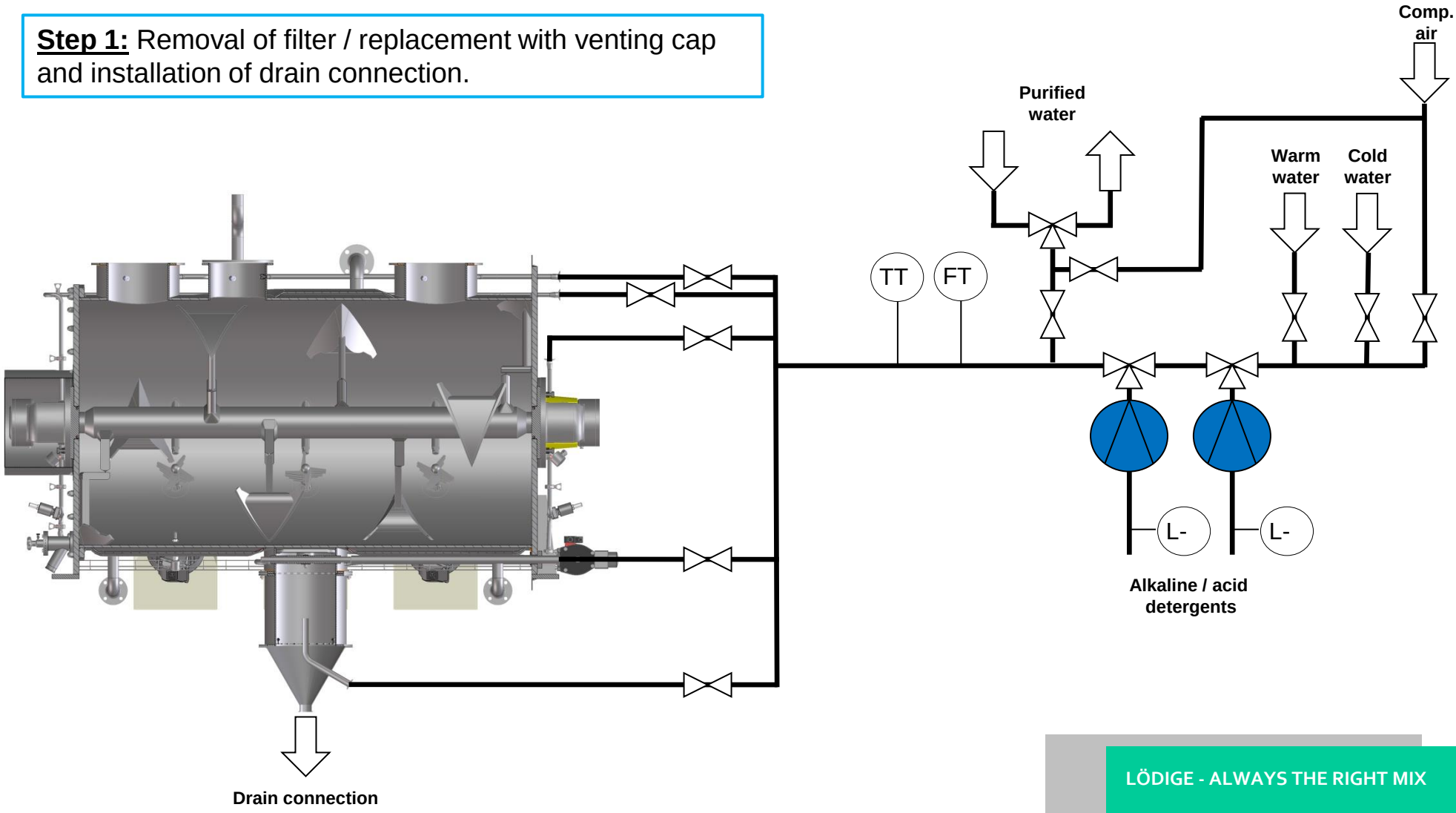
WIP-Process in Ploughshare Mixers

Initial situation



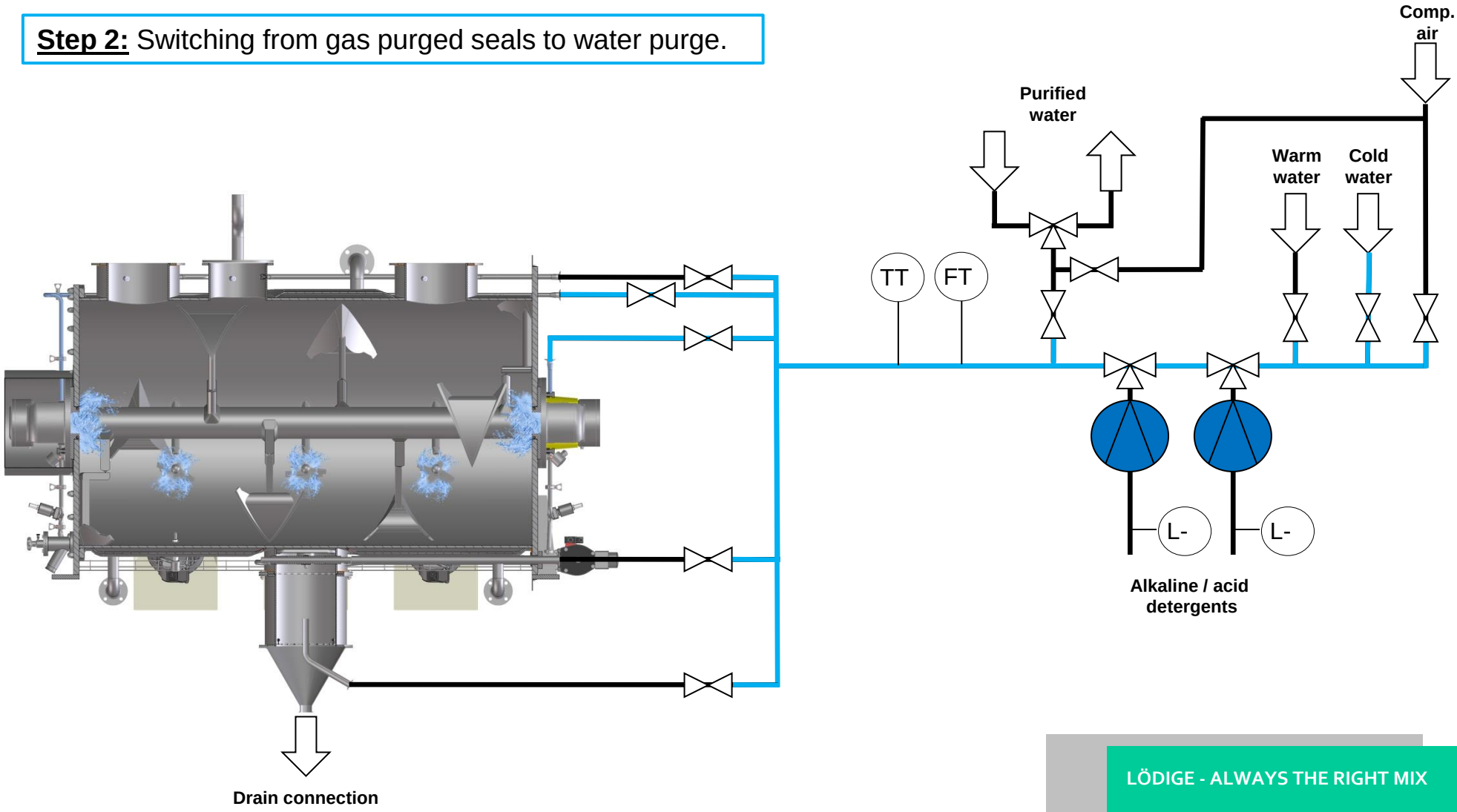
WIP-Process in Ploughshare Mixers

Step 1: Removal of filter / replacement with venting cap and installation of drain connection.



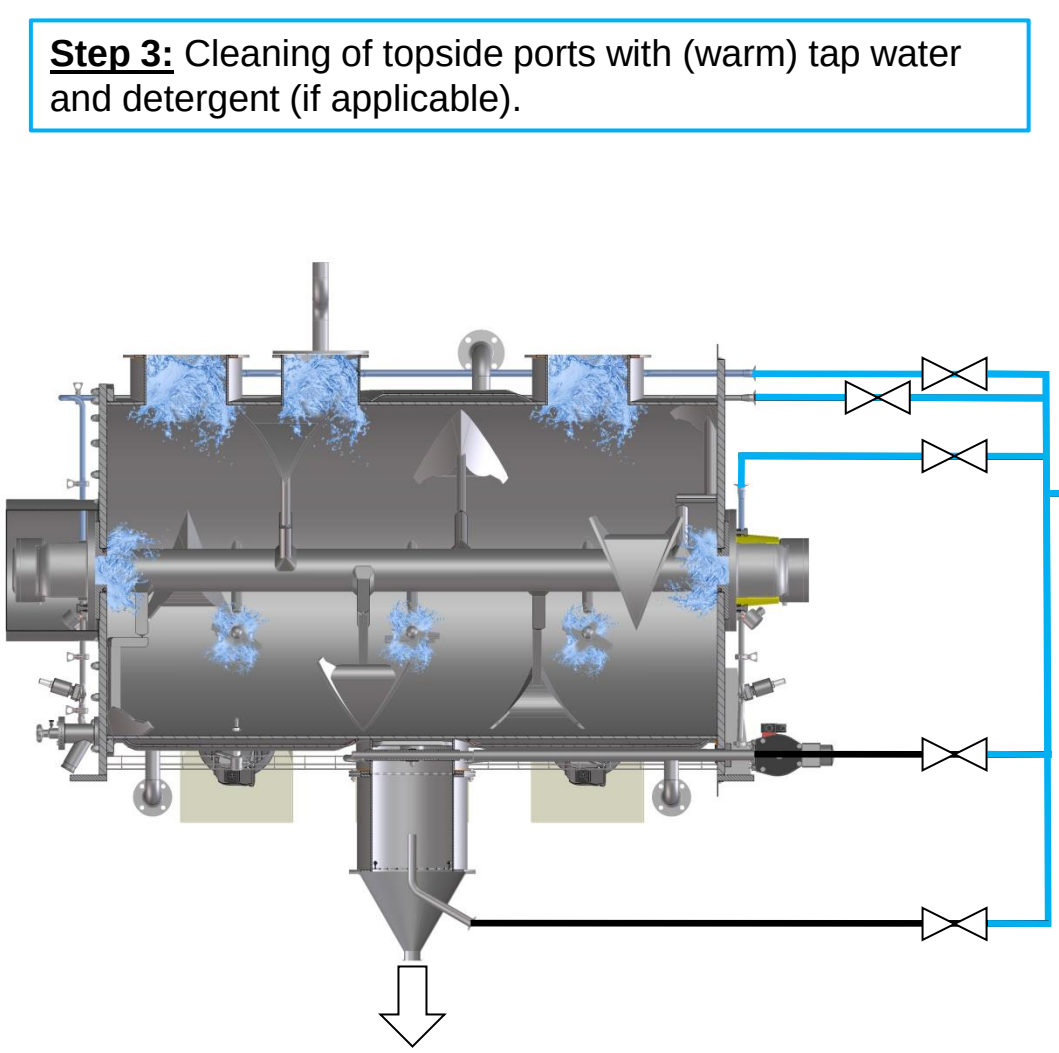
WIP-Process in Ploughshare Mixers

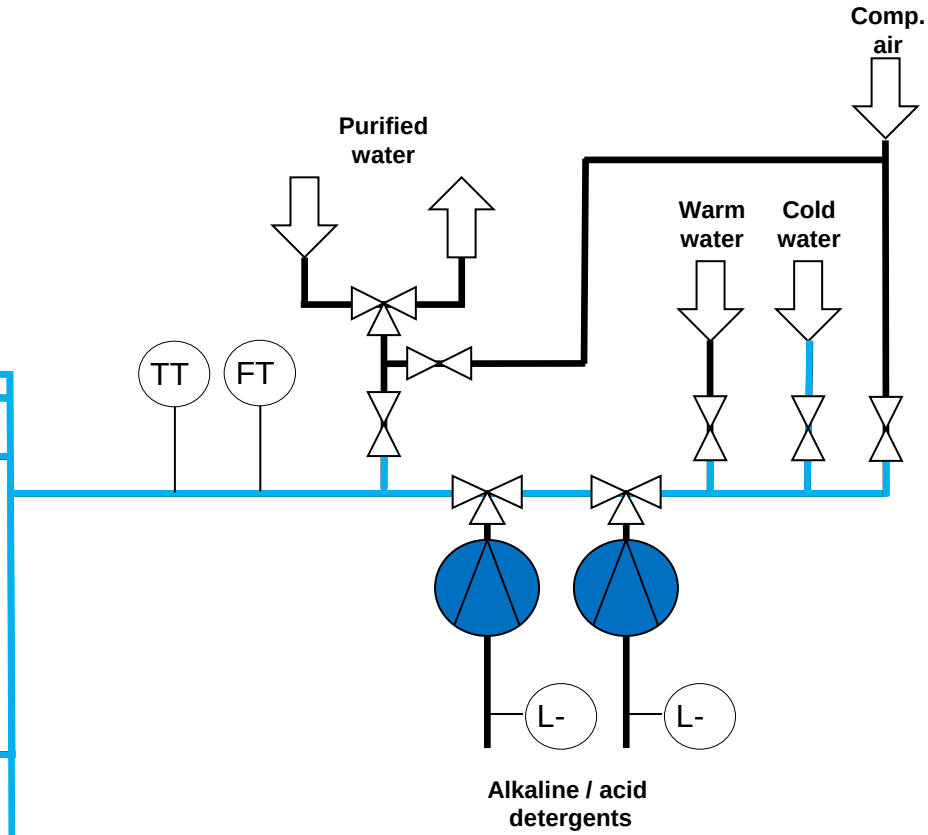
Step 2: Switching from gas purged seals to water purge.



WIP-Process in Ploughshare Mixers

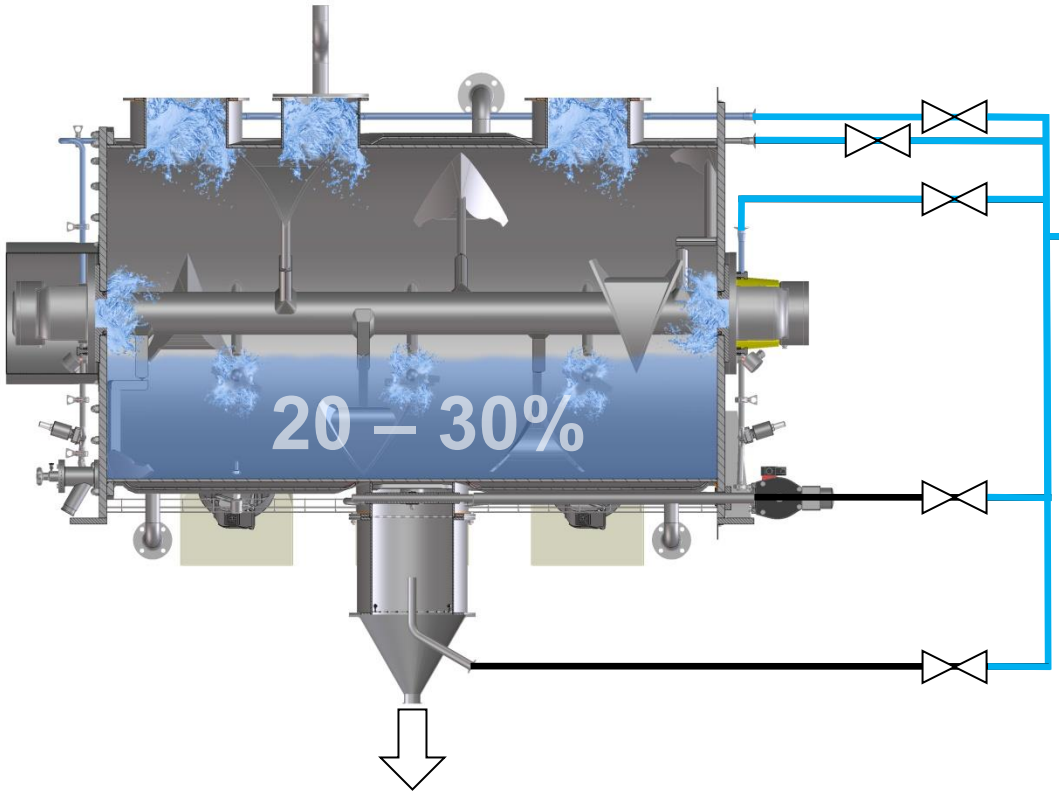
Step 3: Cleaning of topside ports with (warm) tap water and detergent (if applicable).

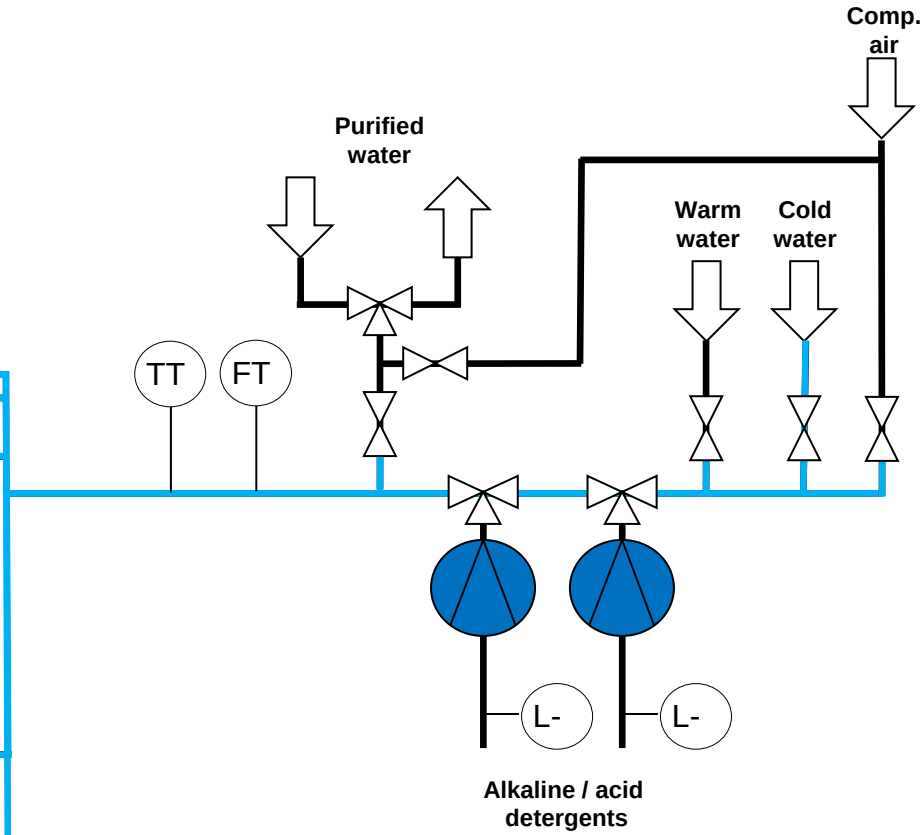




WIP-Process in Ploughshare Mixers

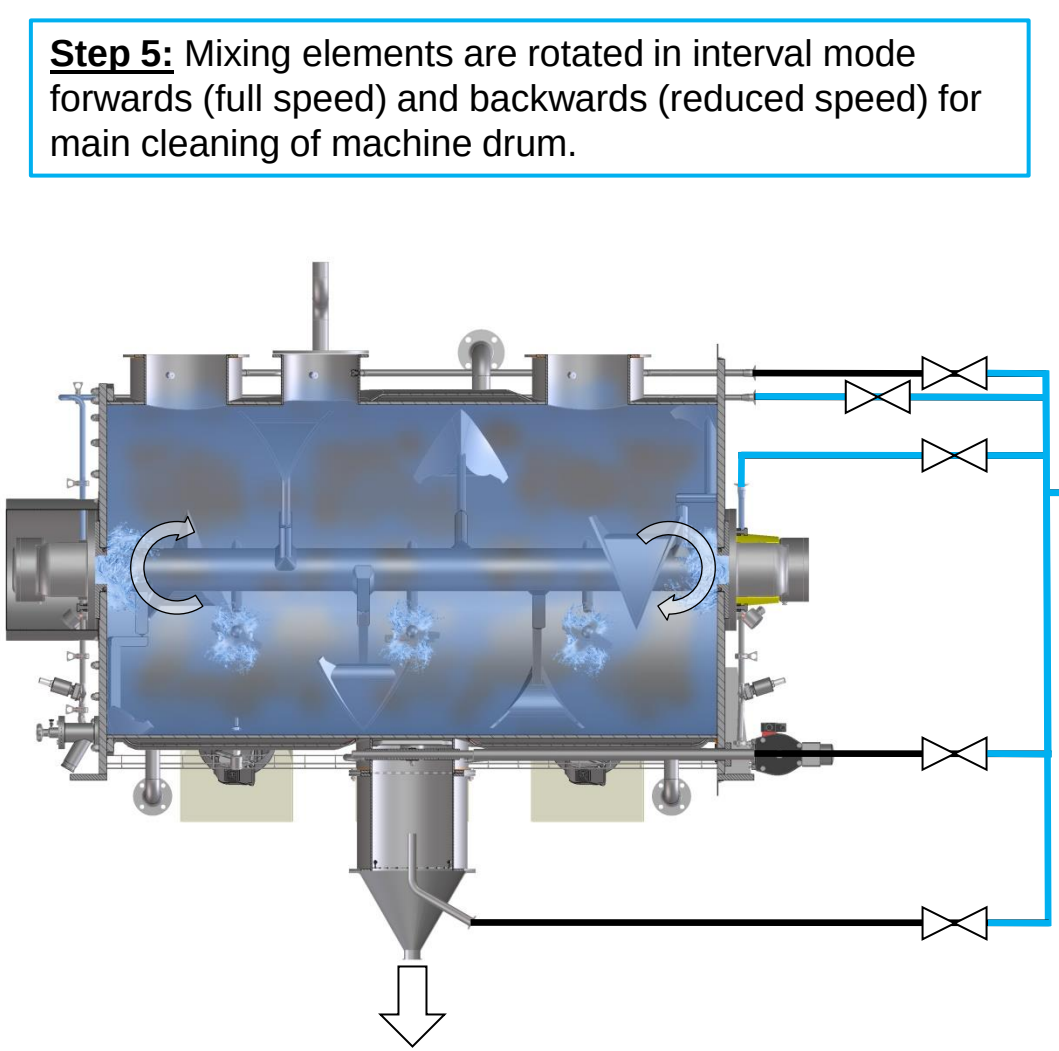
Step 4: All water from previous steps is collected in the machine drum until it is filled up to 20 - 30% with water for main cleaning.

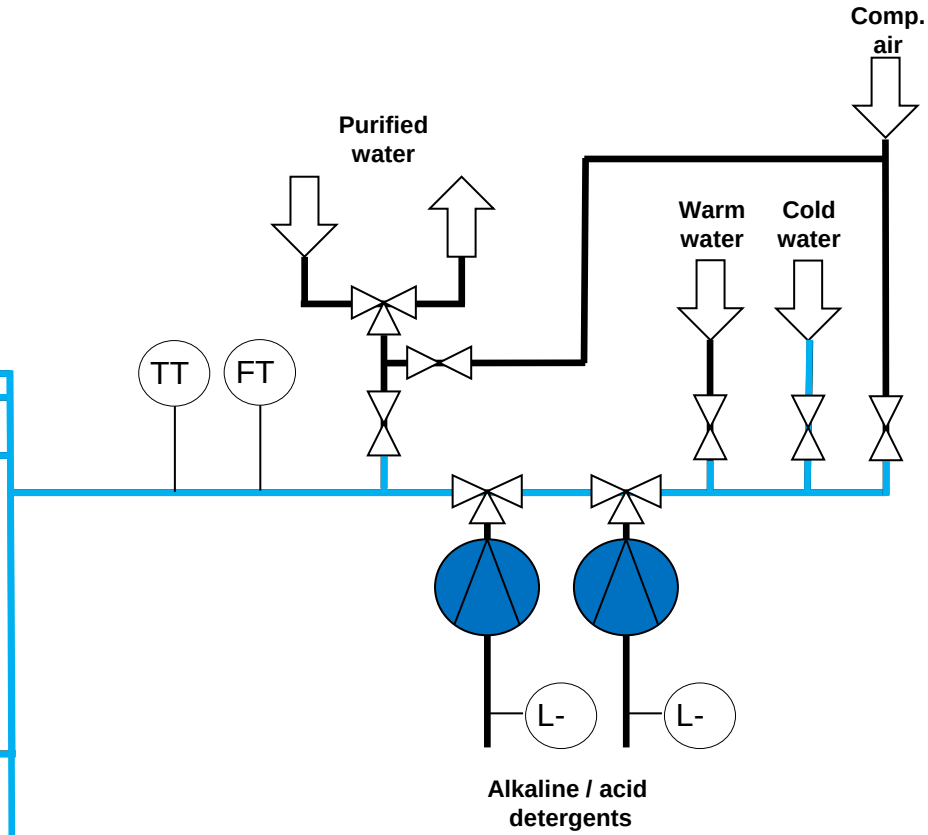




WIP-Process in Ploughshare Mixers

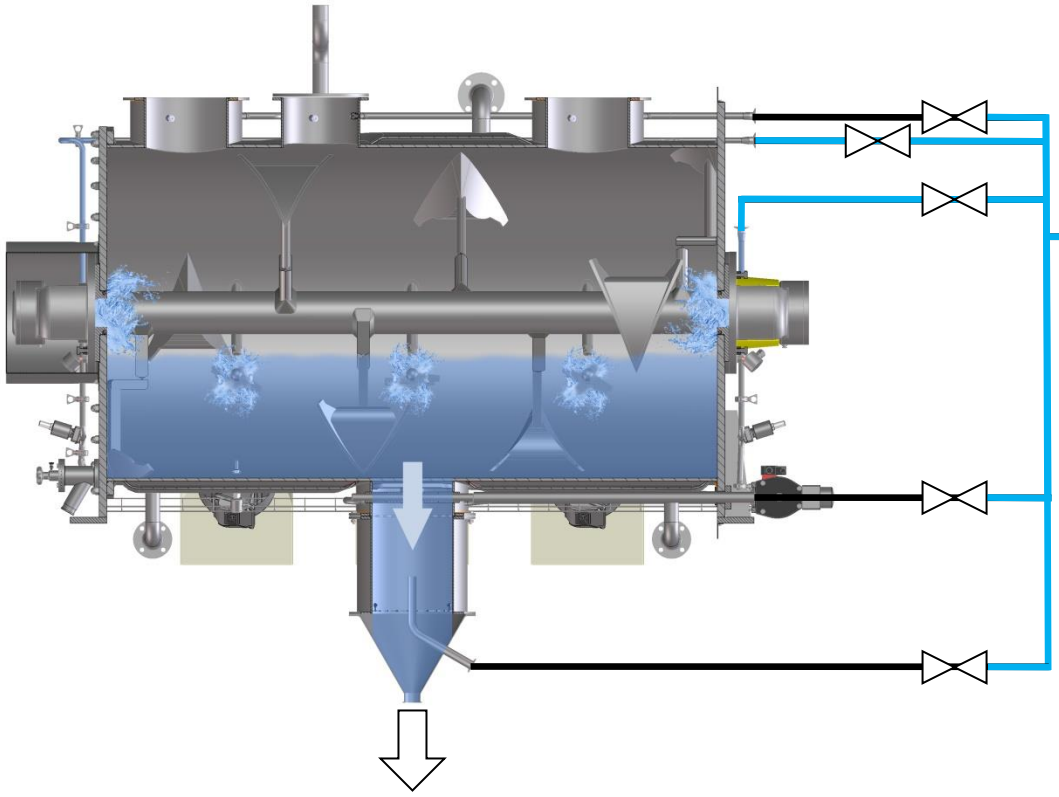
Step 5: Mixing elements are rotated in interval mode forwards (full speed) and backwards (reduced speed) for main cleaning of machine drum.

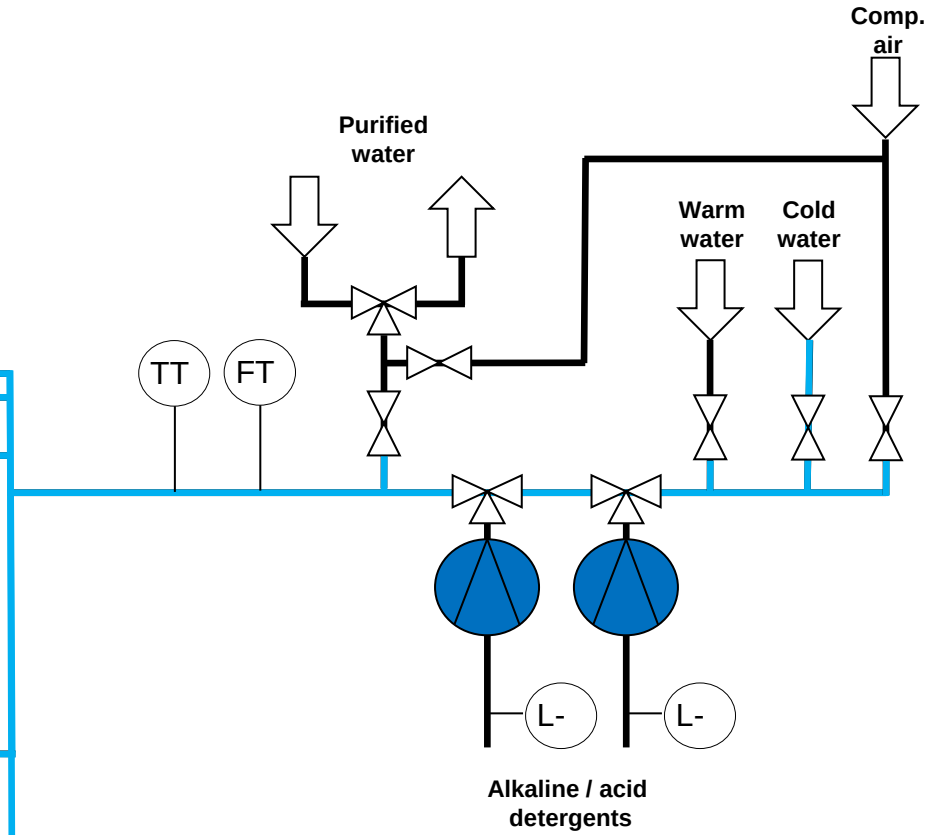




WIP-Process in Ploughshare Mixers

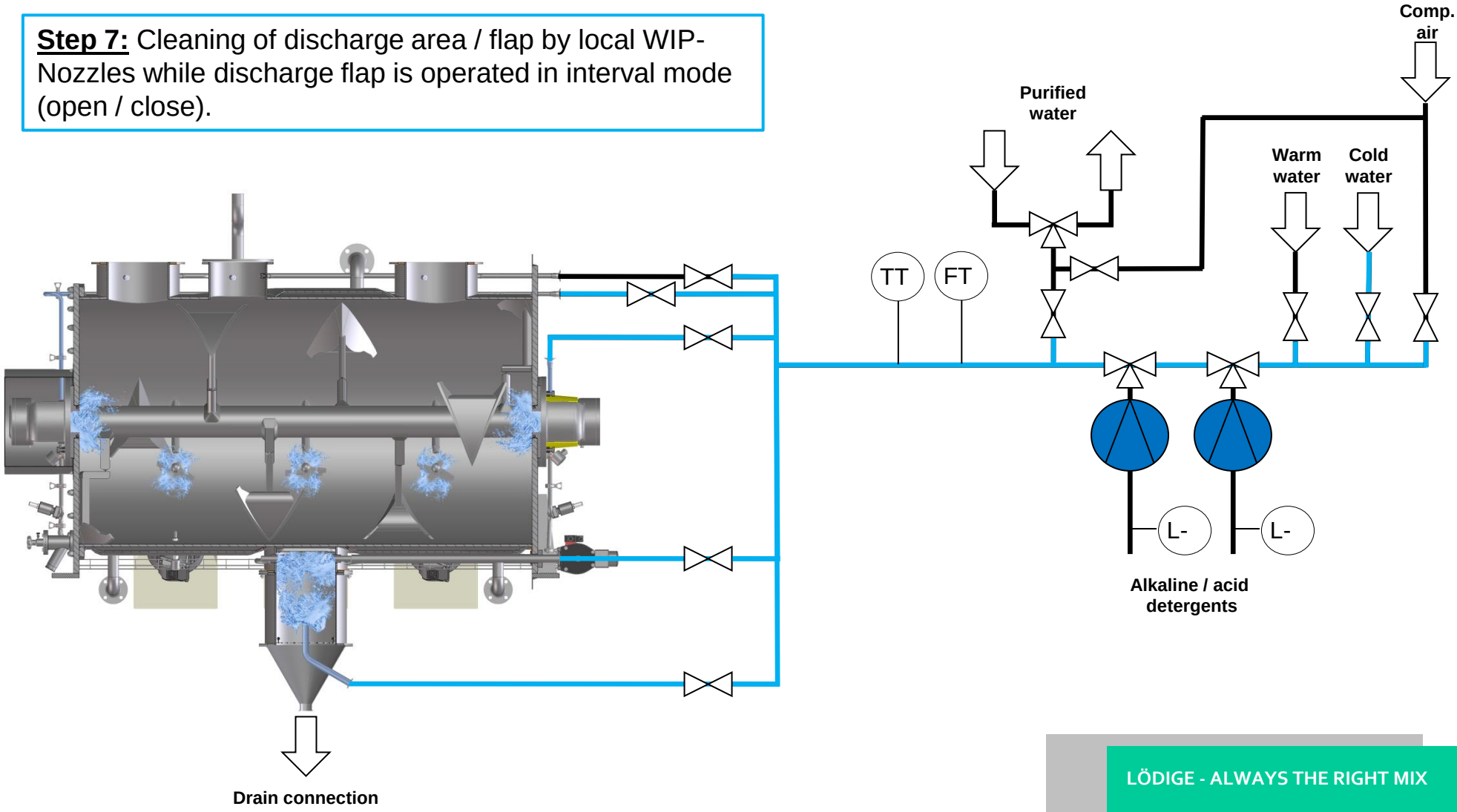
Step 6: Draining of waste water and hereby pre-cleaning of discharge area.





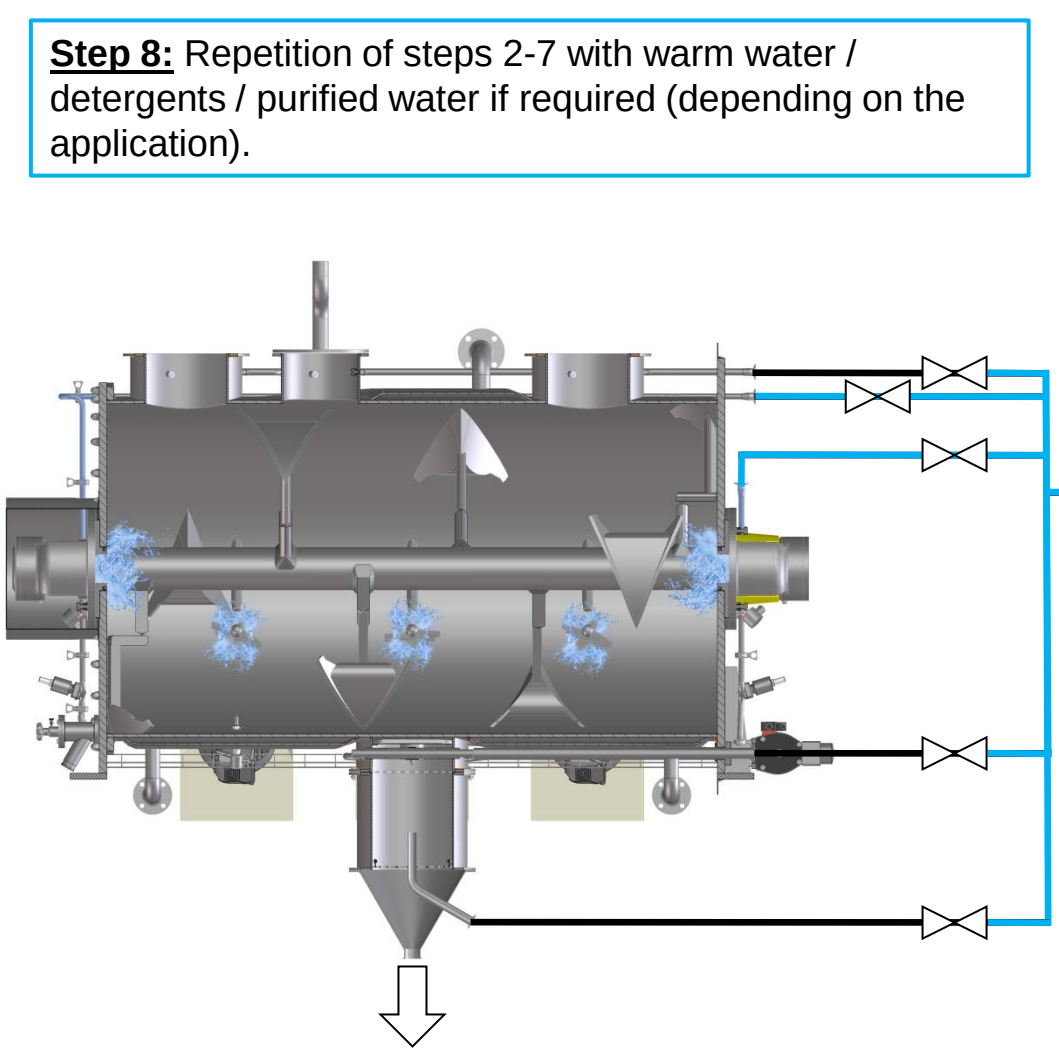
WIP-Process in Ploughshare Mixers

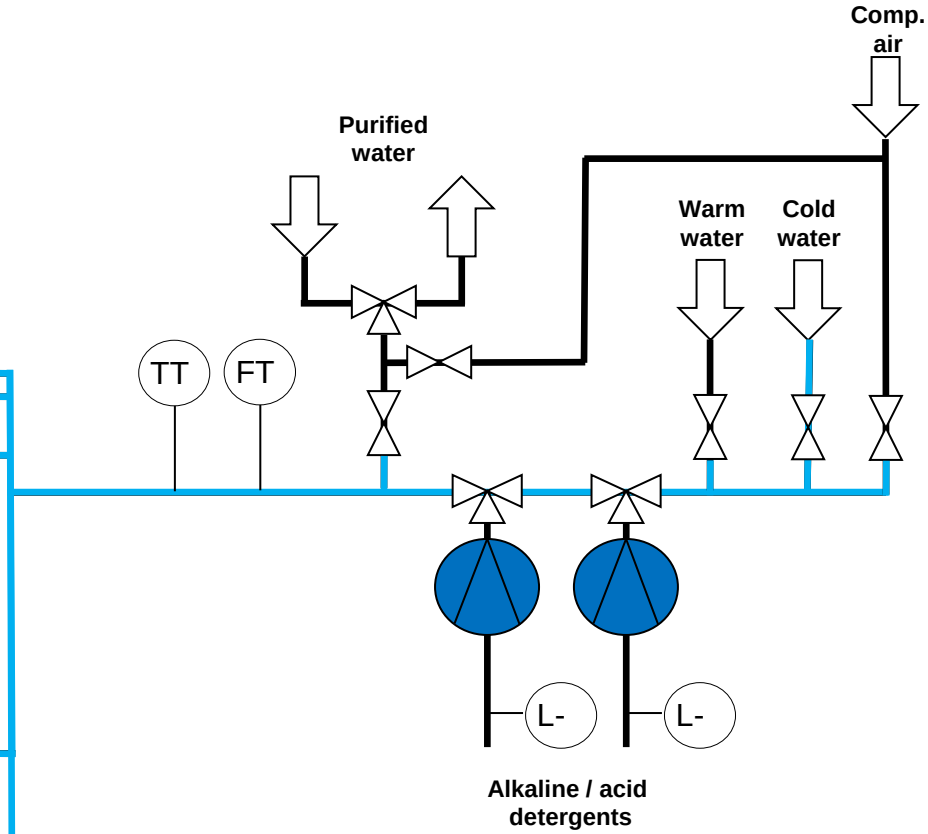
Step 7: Cleaning of discharge area / flap by local WIP-Nozzles while discharge flap is operated in interval mode (open / close).



WIP-Process in Ploughshare Mixers

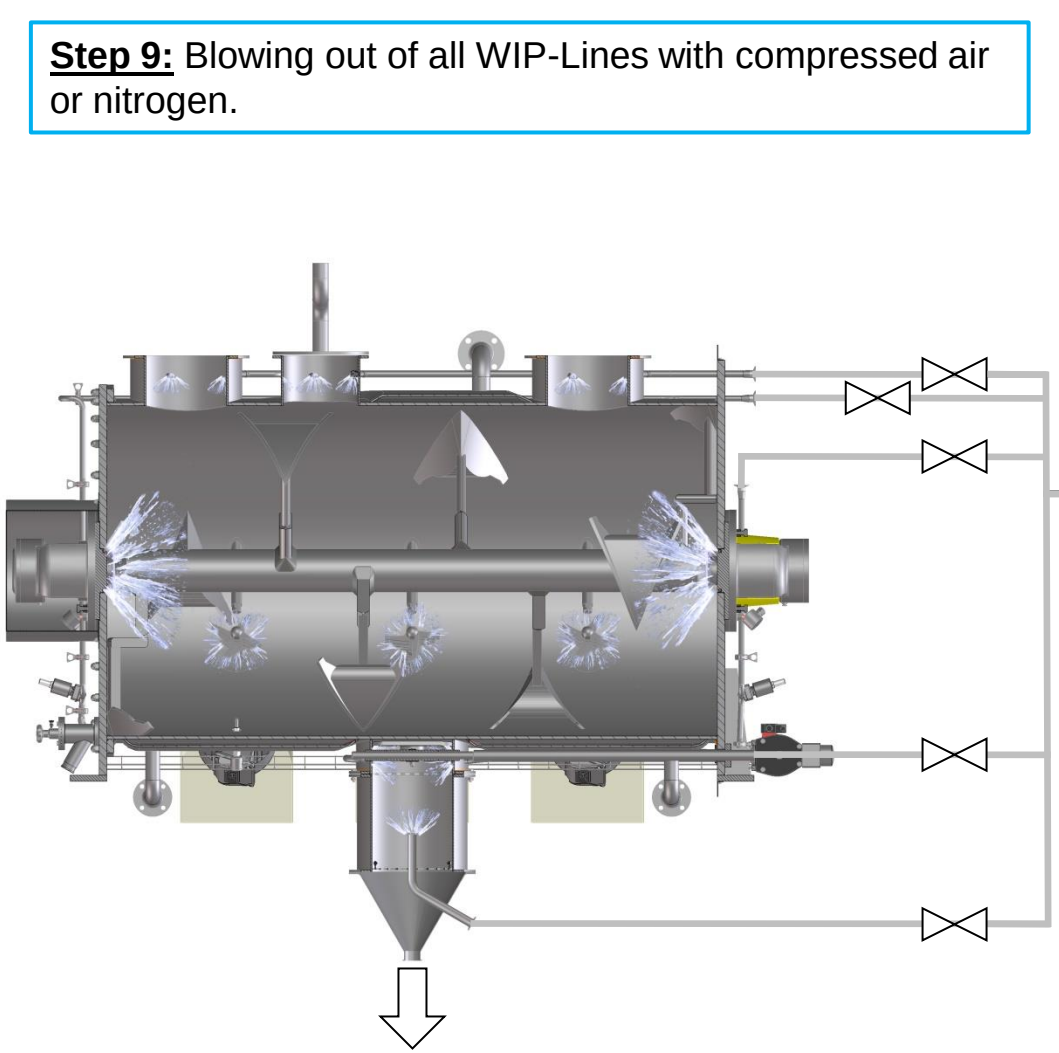
Step 8: Repetition of steps 2-7 with warm water / detergents / purified water if required (depending on the application).

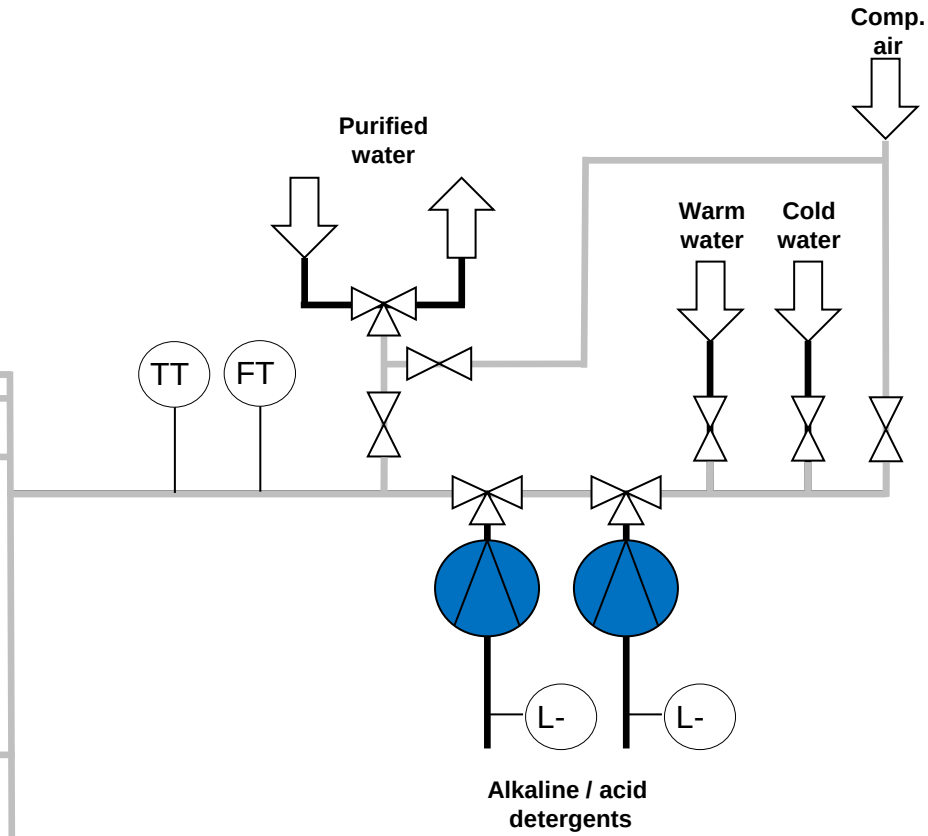




WIP-Process in Ploughshare Mixers

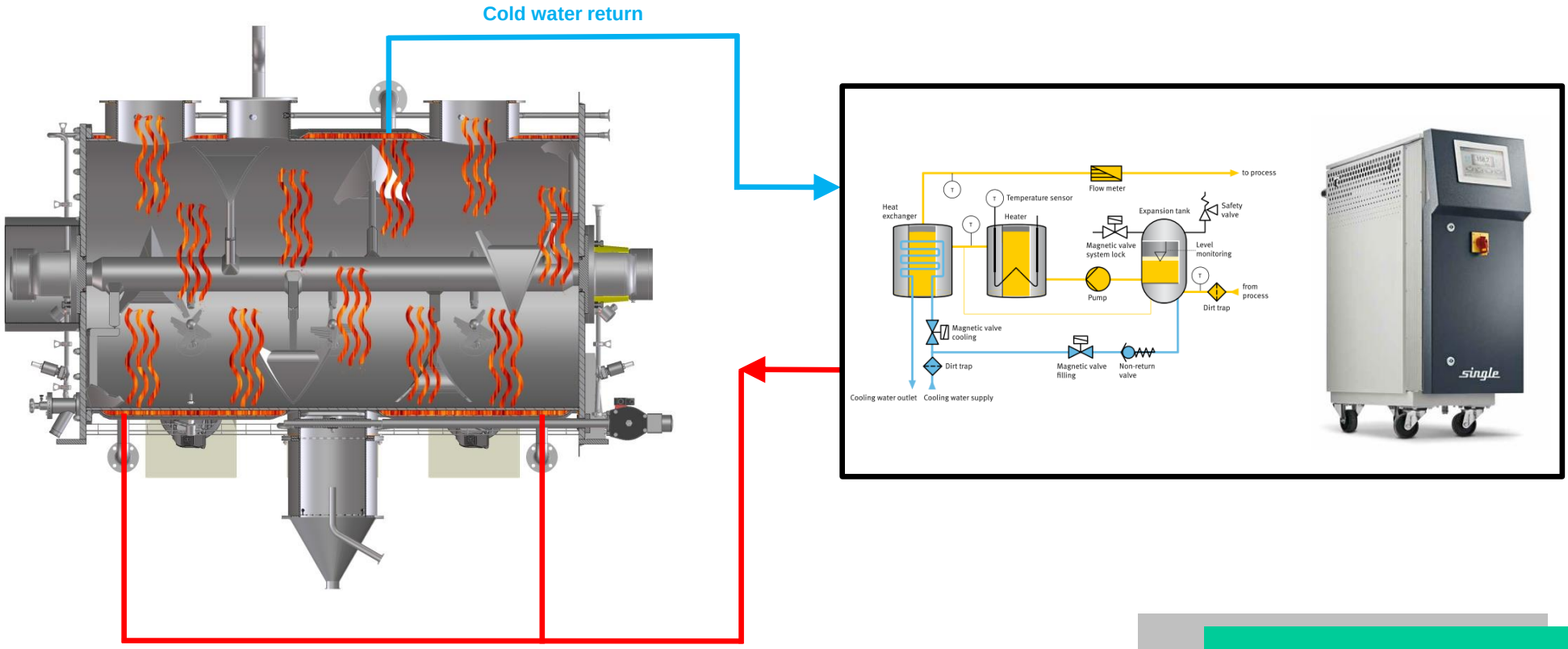
Step 9: Blowing out of all WIP-Lines with compressed air or nitrogen.





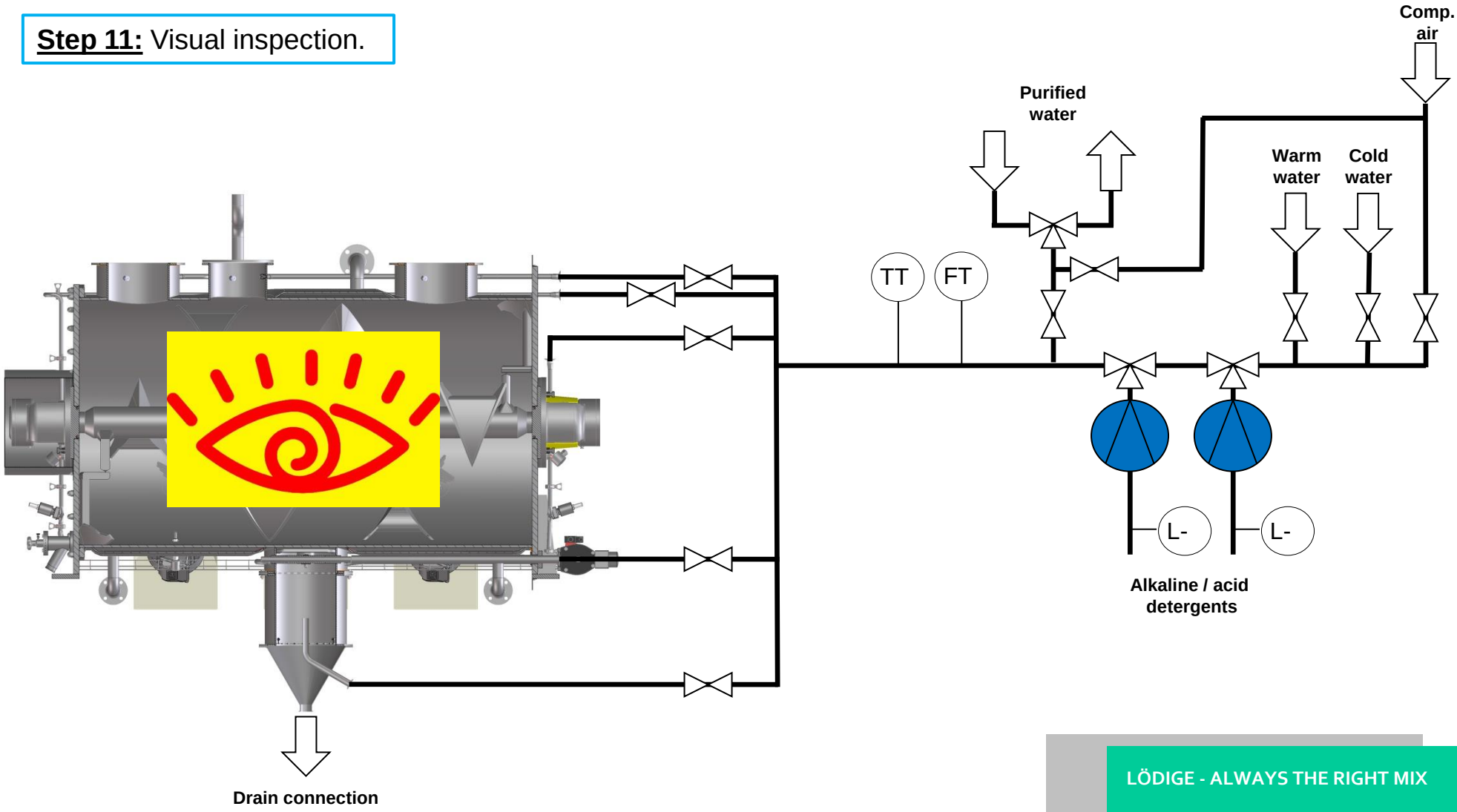
WIP-Process in Ploughshare Mixers

Step 10: Machine drying by usage of ambient air / temperature control jacket / hot air blower.



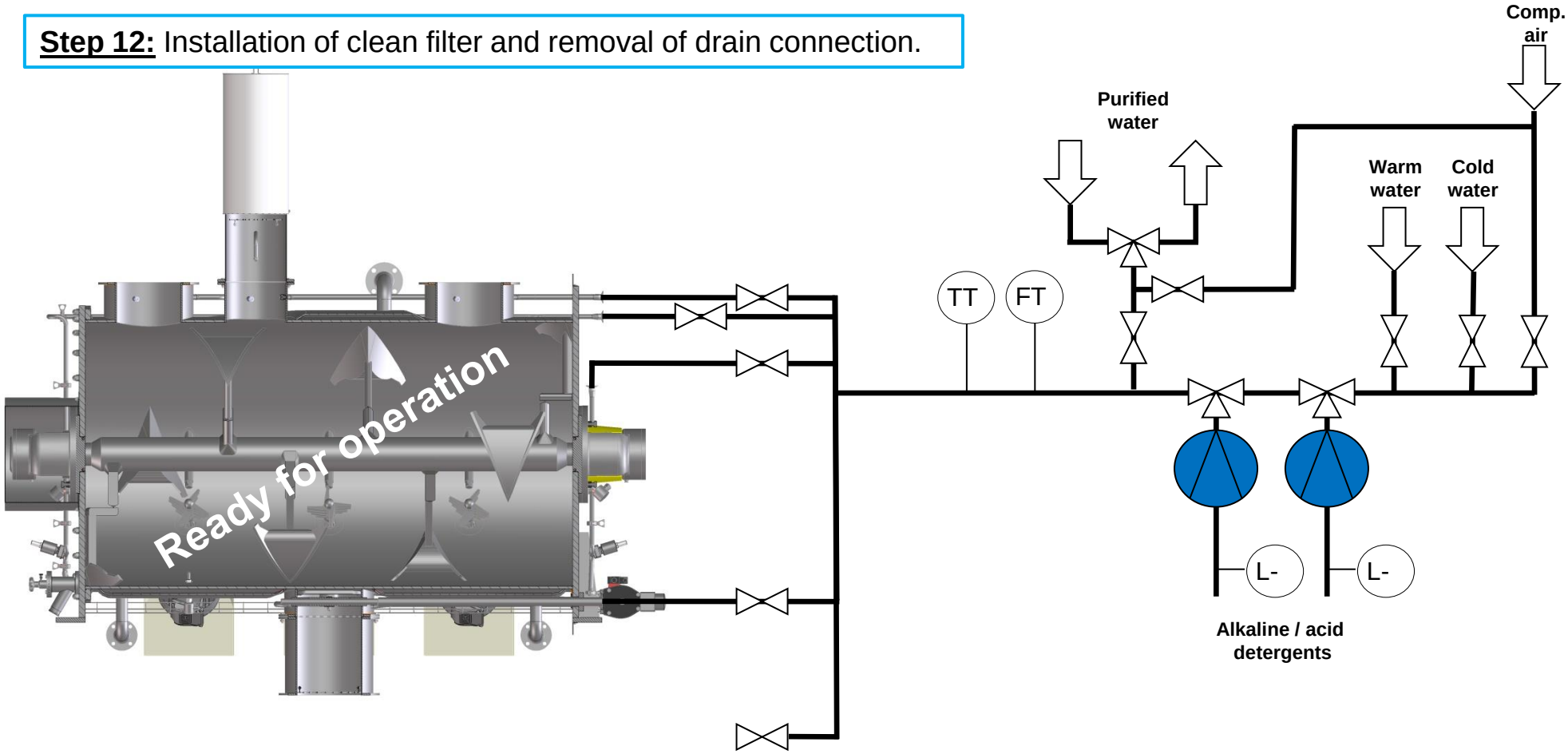
WIP-Process in Ploughshare Mixers

Step 11: Visual inspection.

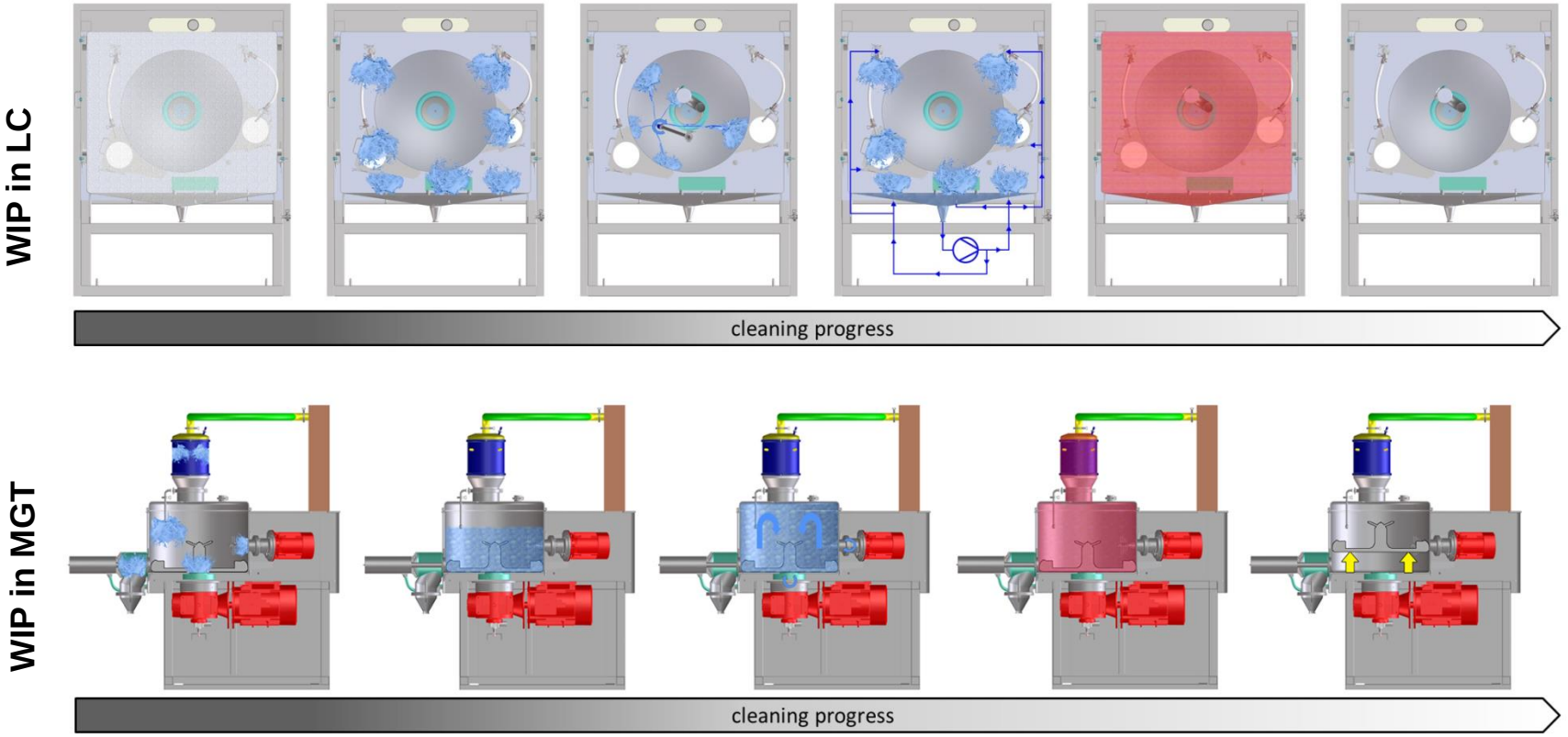


WIP-Process in Ploughshare Mixers

Step 12: Installation of clean filter and removal of drain connection.



WIP-Processes in other machines

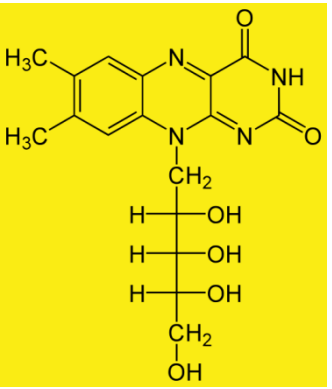


- WIP-Systems are available for almost all Lödige machines but are typically tailored according to customer's needs

Test methods for determining the cleaning efficiency

Riboflavine testing basics

- Riboflavine is a water soluble vitamin (B2) with strong yellow colour
- Riboflavine glows if it is illuminated with ultraviolet light
- It's used as tracer for visual inspection of the WIP-System functionality and the efficiency of WIP-Nozzles
- Riboflavine testing has been established as one of the most common cleaning tests for pharmaceutical / food grade machines
- A guideline for a typical Riboflavine testing procedure was created and published by the VDMA



Riboflavine testing guidelines

Process Plant and Equipment

VDMA

Information sheet

Riboflavin test

for low-germ or sterile process technologies

Fluorescence test for examination of cleanability

For food, aseptic, pharmacy and chemistry

Edition December 2007

Verfahrenstechnische Maschinen und Apparate

VDMA

Merkblatt

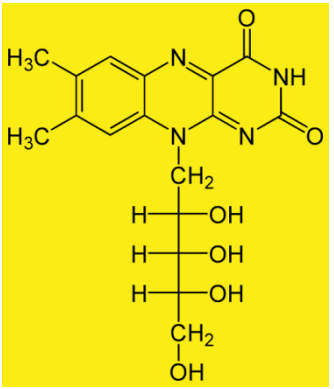
Riboflavintest

für keimarme oder sterile Verfahrenstechniken

Fluoreszenztest zur Prüfung der Reinigbarkeit

Für Lebensmittel, Aseptik, Pharmazie und Chemie

Ausgabe Dezember 2007

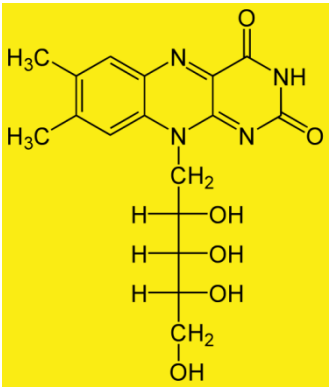


- Handout

Riboflavine testing

- Aims of testing (according to VDMA guidelines):

Riboflavine test:	Aim of test:	Criterion of quality after testing:
Weak point test	Localizing critical points; provided as optional preliminary stage to the cleanability test.	Visible fluorescence at critical points; these are to be confirmed through a cleanability test.
Cleanability test	Verification of full cleanability.	No visible fluorescence.
Optimization test	Stepwise optimization and checking of suitability of new parameter values through separate, new cleanability tests.	No visible fluorescence and improved parameter values (e.g. reduced water consumption, shorter cleaning times, etc.)



Riboflavine testing procedure

Step 1: Creating of a Riboflavine solution with specific concentration and filling into spraying equipment

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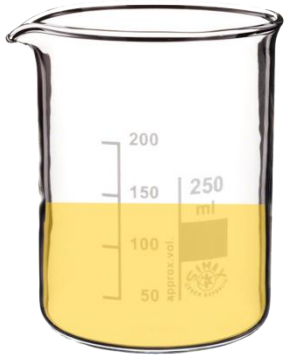
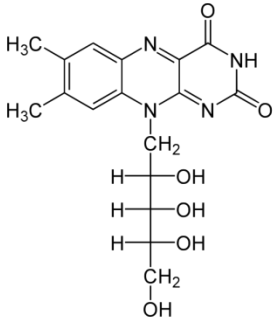


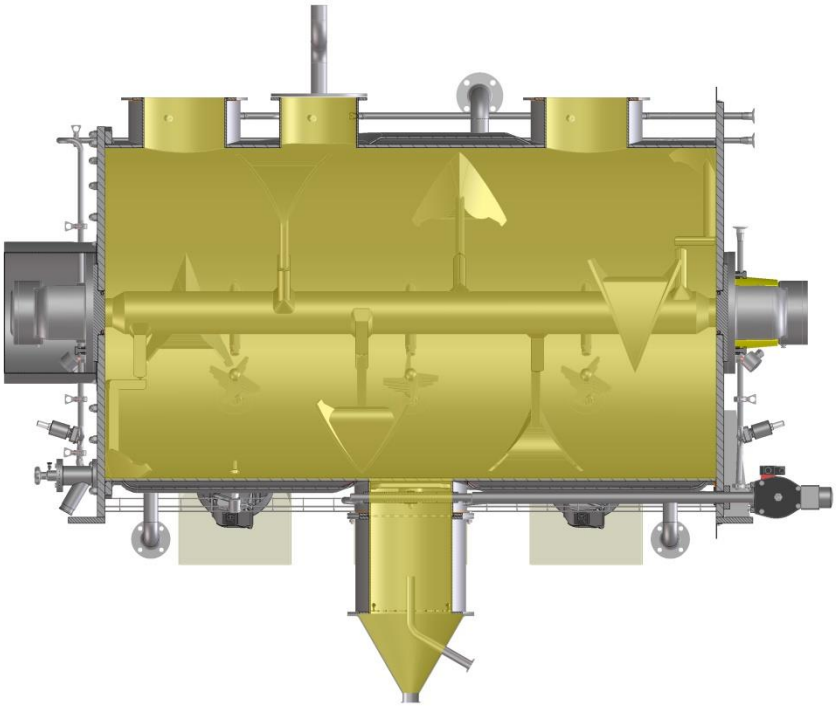
Riboflavine



Due to the intensive coloring effect from Riboflavine a 0,02% solution is sufficient for testing

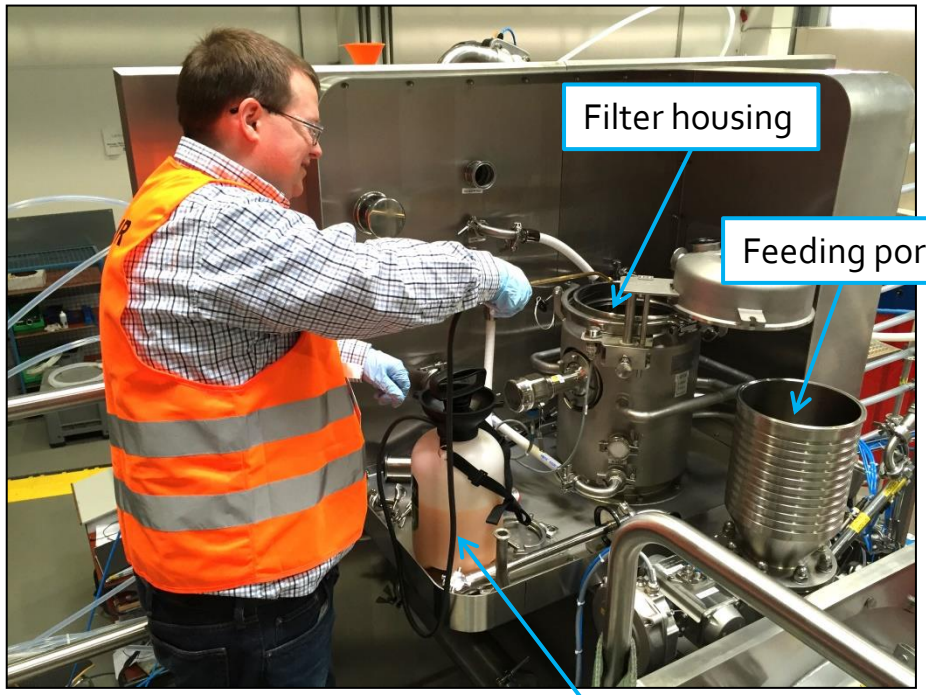
Riboflavine testing procedure

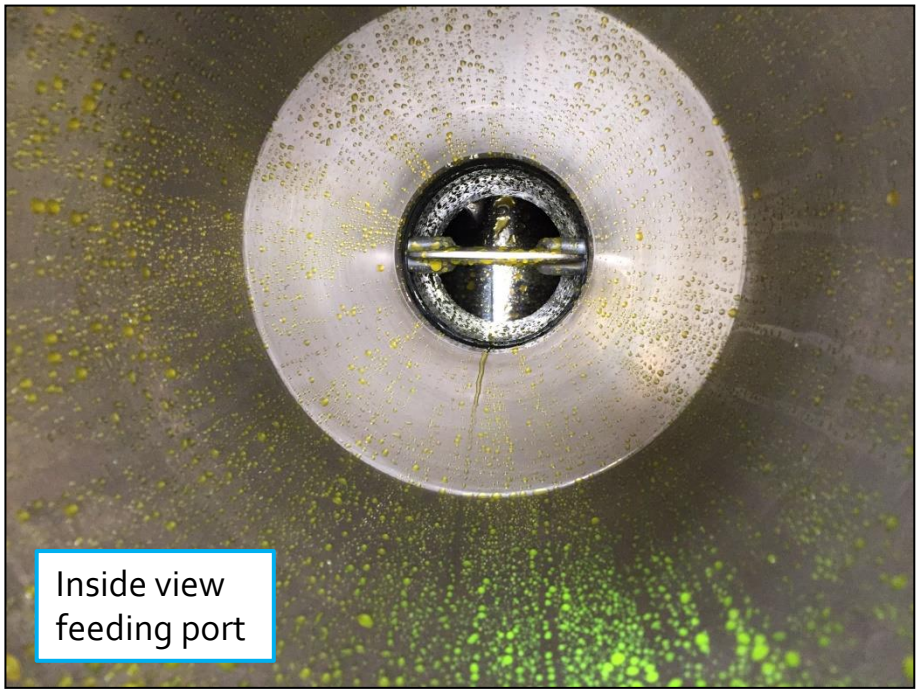
Step 2: Spraying the Riboflavine solution on all product contact surfaces.



Riboflavine testing procedure

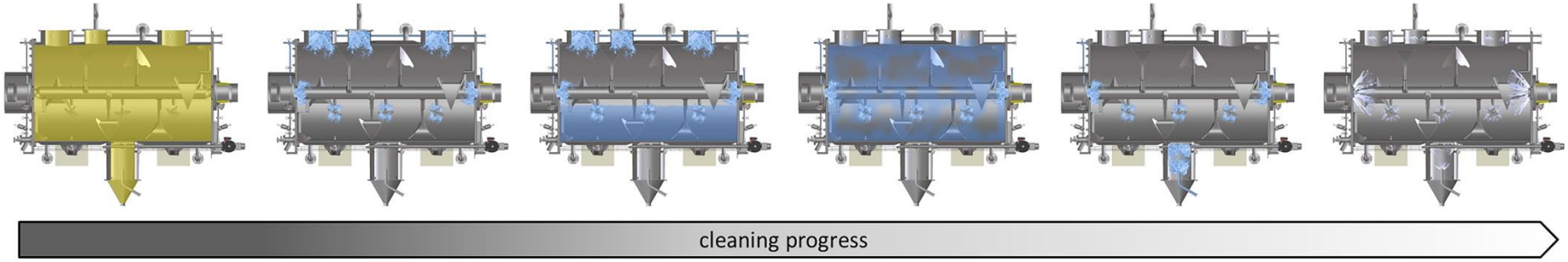
Step 2: Spraying the Riboflavine solution on all product contact surfaces.





Riboflavine testing procedure

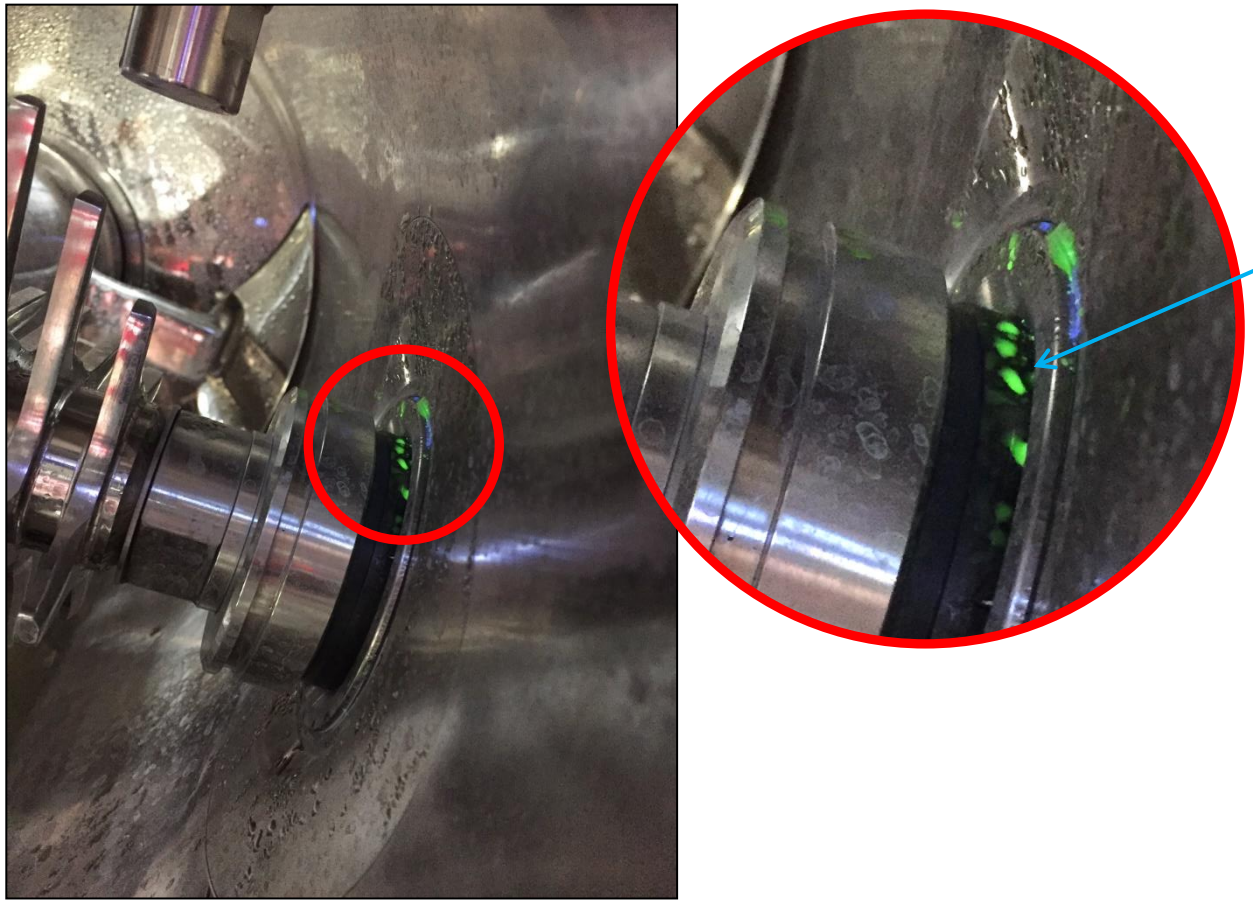
Step 3: Running a full cleaning cycle.



Step 4: Visual inspection with UV-light / documentation of results.

Riboflavine testing procedure

Step 4: Visual inspection with UV-light / Examples for findings.

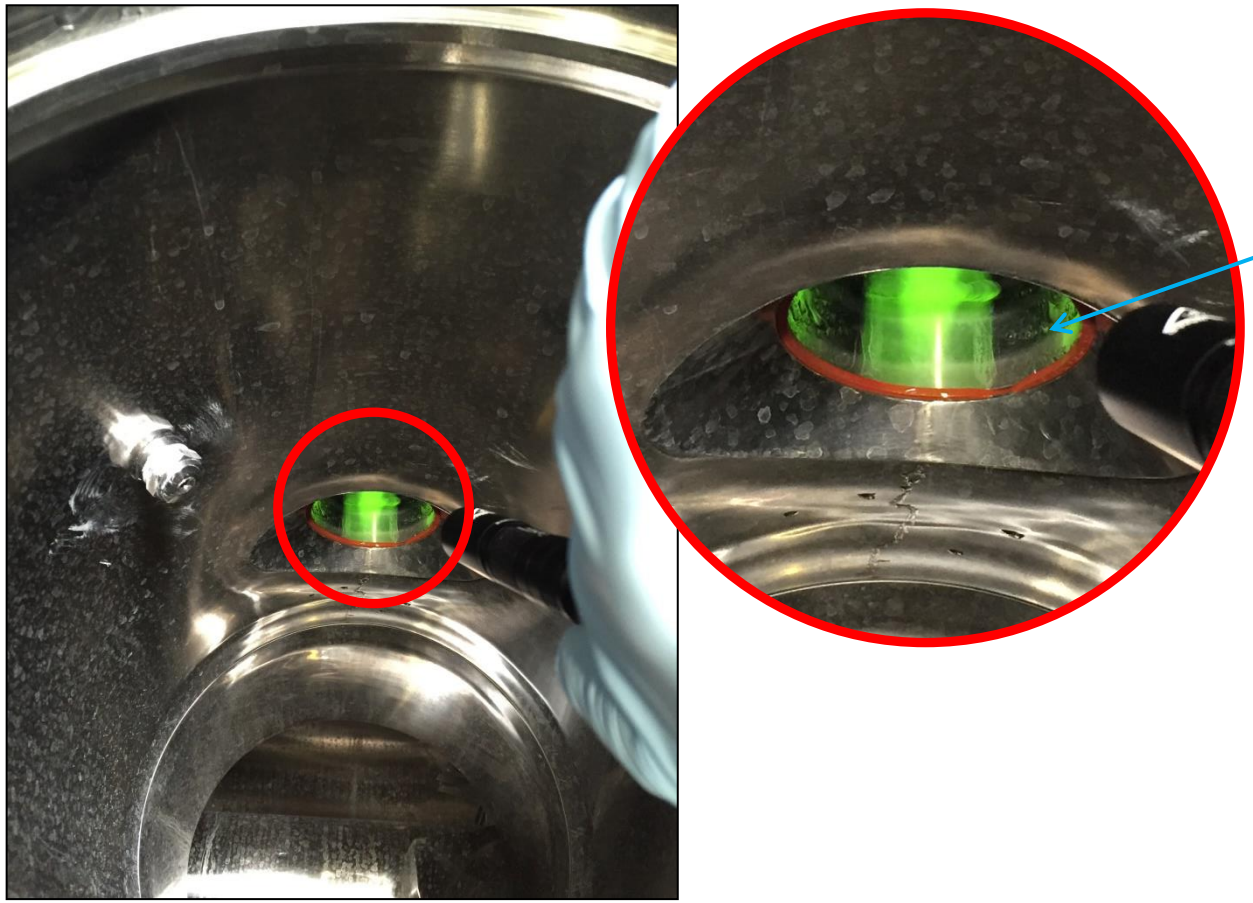


Weak point detection:
Spray shadow behind shopper seal.

→ Machine needs a higher filling degree during main cleaning as spray nozzles can't cover this area.

Riboflavine testing procedure

Step 4: Visual inspection with UV-light / Examples for findings.

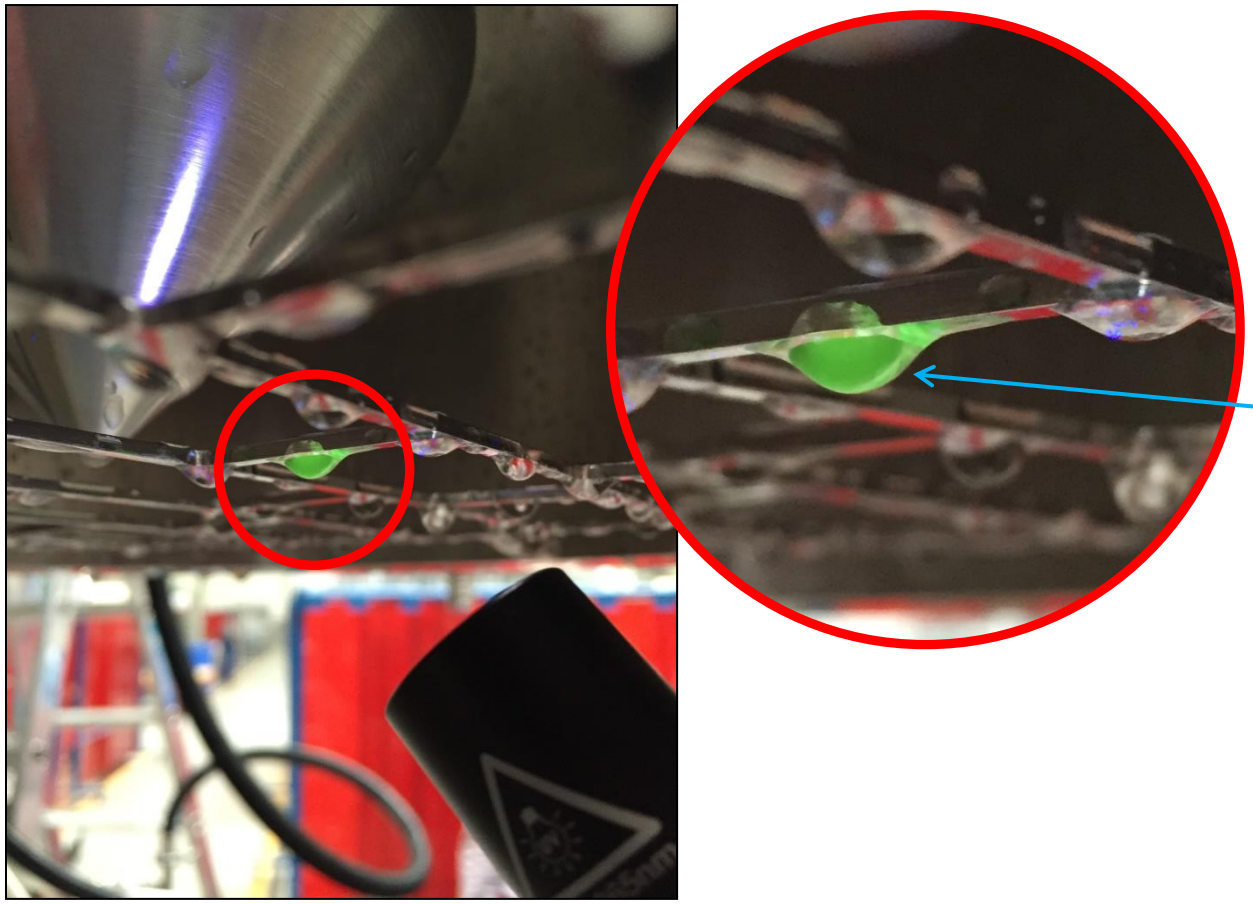


Technical issue detection:
Rotating jet cleaner does not turn correctly and does not cover a lateral installed flange

→ Rotating jet cleaner was dismounted, checked and repaired (turning mechanism was blocked)

Riboflavine testing procedure

Step 4: Visual inspection with UV-light / Examples for findings.

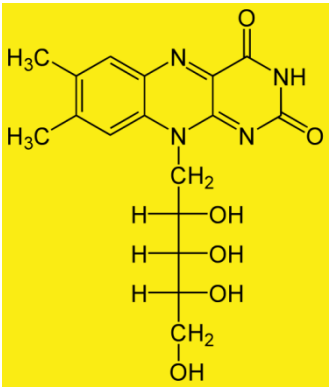


Safety grids are difficult to clean as they're in contact with all waste water and have a complex surface

→ Cleaning recipe needs to be modified with additional cleaning cycles for discharge area at the end.

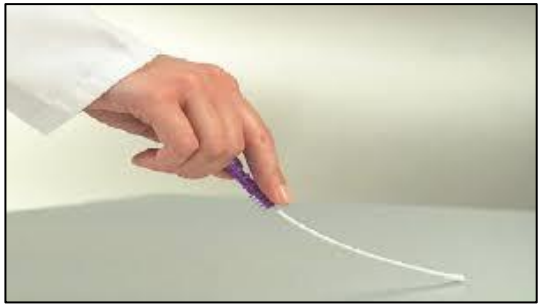
Riboflavine testing facts

- Riboflavine testing is good and effective procedure for testing the functionality and performance of cleaning systems
- It helps identifying weak points of WIP-Systems and needs for optimisation of cleaning recipes
- Riboflavine testing can be carried out as part of a FAT or SAT
- **But Riboflavine testing gives just an indication about the functionality of the WIP-System and not about the chemically or biologically cleanliness of the machine and can't be used for cleaning validation**
- Cleaning validation can be carried out by direct contact , swab or rinse testing



Swab Test

- Swab testing is a method for **cleaning validation** by swabbing a defined product contact surface (e.g. 25 cm^2) with a suitable sample material (e.g. cotton wool, cotton stick, etc.) which is solvent impregnated.
- Possible residues of product or other contamination are collected by sample material and can be analysed chromatographically (e.g. by HPLC).
- Swabbing hast to take place on several defined positions in the machine with special sample templates (typically provided as PTFE or Silicon films).
- The overall machine pollution has to be calculated according to the tested surface and the analysis results.
- Swab testing should defined in a SOP.

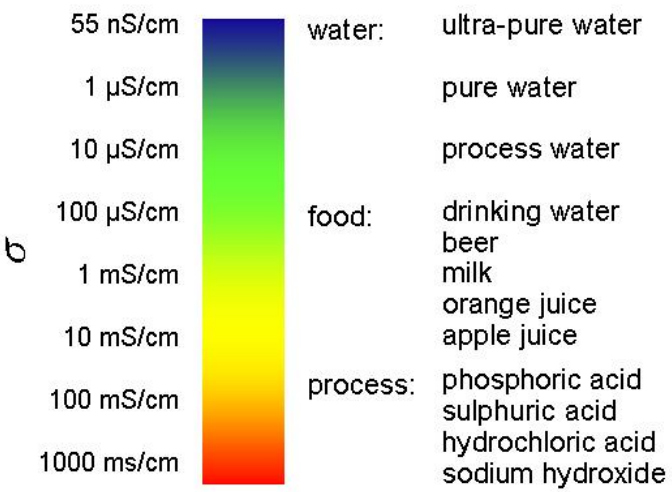


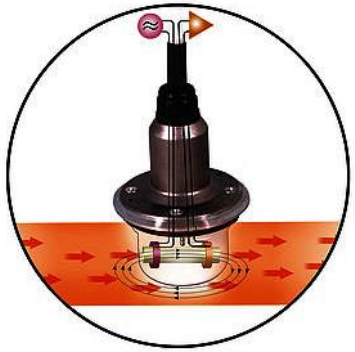
Direct Contact Test (DCT)

- DCT is a method for **cleaning validation** which is used for detection of micro biological contamination of surfaces by usage of special RODAC-plates (Replicate Organism Detection and Counting).
- RODAC-plates have a standardized surface of 25 cm^2 which is covered with substrate and is pressed for 5-10 sec. on the machine's test surface.
- After testing the RODAC-plates are immediately closed and stored in an incubator for a certain period of time for germs growth.
- According to the type of germs and amount of colonies, the grade of pollution can be calculated.
- DCT should defined in a SOP.

Rinse Tests

- Rinse testing is a method for **cleaning validation** by rinsing the whole product contact surface with water or solvent.
- For Final Rinse Testing the cleaning water from the last step of a cleaning sequence (usually AP-water) is collected and analysed. Analysis can take place directly in the waste water line by conductivity measurement.
- For Solvent Rinse Testing an additional solvent rinse of all product contact parts is carried out after a regular cleaning sequence. The solvent is chosen according to product's characteristics. Solvent samples are collected and analysed.





Your contact at Lödige:

Sebastian Steinkamp
Sales - Life Science Technology

Tel.: *+49 5251 309-159*
Mobil: *+49 151 46716814*
E-Mail: *steinkamp@loedige.de*

Thank you for your attention!