



Mixer Washer Clean Paper

Cleaning Upright Cement Mixers

A. Description of the assignment

Producing concrete in planetary or pan mixers makes heavy demands on the raw materials used, the mixing plant itself, as well as the recipes and the cleaning of the mixing equipment to ensure that the quality of the product is consistently high. In addition to this, the pressure from competition and costs is also very high in this field of work. The cleaning of the mixer has an impact on the wear and the operational readiness of the system, not to mention being a decisive factor in the quality of the manufactured product. An ideal cleaning solution for cement mixers would provide a complete and thorough clean with a minimal amount of resources, dispense with the need for personnel and only entail very brief downtimes.



B. Automatic cleaning of the mixer with high pressure nozzles

1) Technology

High pressure spray heads that are mechanically guided to reliably reach every point in a predefined three-dimensional area, have been used for over 30 years in automatic cleaning processes for the inside of containers. The scope of use ranges from storage and transport tanks to different production containers in the chemical and pharmaceutical industry or in food production. Even unwanted deposits and fixed impurities in wine barrels are cleaned using this method (e.g. tartar).

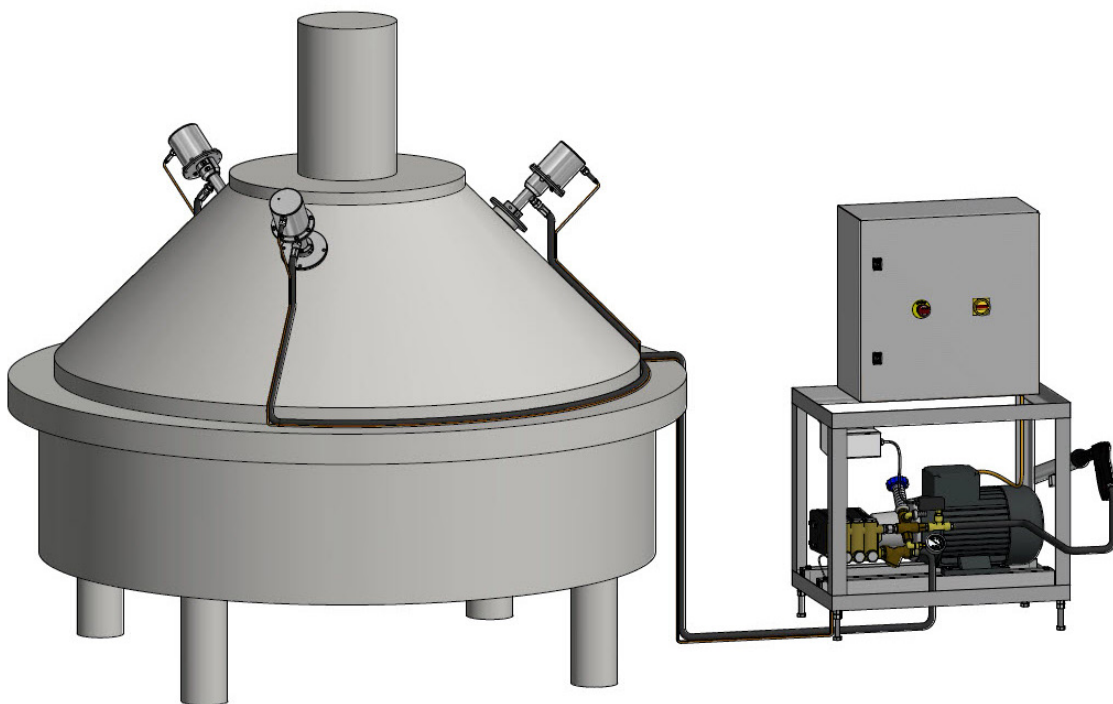
Depending on the water pressure, there will be a difference in the low pressure (line pressure, with a pressure increase of up to max. 25 bar), medium pressure (25 to 80 bar), high pressure (from 80 bar) and maximum pressure (from 1000 bar).

When cleaning in the high and/or maximum pressure range, the water jet generates a strong physical impact force, which mechanically dislodges fixed or dried substances from the container walls and the mixer without any prior treatment. The dissolved dirt particles are washed away with the water.

2) Complete system

The core components of an automatic high pressure cleaning system for mixers are: fresh water, depending on availability either directly from the mains or from a reservoir, a pump assembly, consisting of an electric drive and a high pressure pump, sufficient to supply 150 bar because we only work at 120 bar and with 50 litres of water per minute, as well as several high pressure spray heads (3 to 4 units, depending on the size of the mixer), which are permanently installed in the upper part / lid of the mixer.

In addition to this, there are the necessary supply lines for supplying the pump with water and forwarding the water on to the high pressure spray heads via high pressure hoses or tubes. A joint control system for the pump assembly and the drives of the spray heads is also required to operate the cleaning system.



Several manufacturers already offer automatic cleaning systems as an option with the purchase of a new plant. Mixers that are already installed without their own automatic cleaning system can only then be upgraded with the necessary equipment at great effort and expense. Having mounting holes for the spray heads already in the mixer's lid is a decisive factor here. All the other components for the cleaning system (pump assembly, high pressure pipes and power supply to the spray heads, control system) can be installed later on without great effort or expense.

3) High pressure spray heads

The use of these systems in cement mixers is particularly demanding for the spray heads. In addition to fulfilling the required parameters of high pressure (water pressure and quantity), the geometry of the cleaning area as well as the sealing of the spray heads are also pivotal for preventing dust and cement from entering the rotary points and seals, thereby avoiding any premature wear. Furthermore, the cleaning equipment must withstand the, at times, strong vibrations during the mixing process and the loading of the mixer.

In contrast with many other containers, not all of the inside of a mixer has to be cleaned with high pressure, the upper part of the mixer is deliberately left untouched. This is done by setting the angle of the spray head's swivel joint at 45° in conjunction with placing the outlet nozzles in the correct position. The nozzles themselves are designed as jet nozzles in order to create as strong an impact pressure as possible on the surface. To protect the mechanical gearing mechanism, the spray head is sealed and all rotary points are specially protected from dust.



RW Spray Head

The spray heads are placed in the mixer in such a way that the high-pressure jets can reach all the dirty parts of the mixer and the spray heads can also spray the other heads clean. That is why the spray heads can be vertically adjusted via the flange with a clamping ring.

The spray heads are powered by their own electric motor; in other fields of application, compressed air or water-hydraulic drives are also used.

4) Pump assembly

A pump assembly supplies the cleaning system with the required amount of water at the necessary pressure. This involves the combination of a high pressure pump with a corresponding drive, usually an electric motor, which is connected to the pump with a flexible coupling.

Piston pumps are usually used to create the compression in high pressure cleaning applications. This process works in a similar way to a car's engine, however instead of producing rotation energy the inverse happens as it is used as a drive and thereby compresses the medium in the piston.

The part of the pump subjected to the greatest amount of stress is the piston itself as it moves quickly into the cylinder, transmits significant forces during the compression process and heats up considerably due to the compression of the medium. In order to achieve high thermal stability with minimal harshness to the surface and a high wear resistance, pistons are often used in pumps for professional applications, and the external surface or entire piston is made of ceramic. Although production is more expensive, this significantly increases the service life.

Electric motors are used to drive the pumps, their output being adapted to suit the capacity of the pump; for cleaning mixers this is usually based on the number of spray heads in the range from 10 to 15 kW.

5) Cleaning process

The mixer should be thoroughly cleaned before every break in production to prevent any residual material fully hardening on the surface (,deep clean'). An ,intermediate clean' should also be performed before each new batch with a different recipe or other colour pigments so the quality of the product is not compromised by any residual material.

A deep clean should be performed every 4 hours, as well as at the end of the working day and before a more prolonged period of inactivity. An intermediate clean should be incorporated every 2 hours.

The requirements for an intermediate clean are low, so a shorter cleaning program is sufficient for this purpose, which means the cleaning time and water consumption will be reduced too.

When the cleaning system is integrated in the overall control system of the mixer, the respective cleaning cycle is started by its control system. It selects the cleaning program (deep / intermediate clean); the corresponding process parameters (running time, pressure and volume of water) are assigned to the respective program.

If the cleaning system is operated separately, this is started with a dedicated switch, which, in addition to the pump assembly, also switches the drives for the spray heads. If necessary, this is coupled with a timer to automatically stop the cleaning process.

During the cleaning process, the spray heads rotate, while the high pressure jet is discharged from each nozzle. Because each jet is mechanically guided, every point in the mixing container and the mixing mechanism is reached once after 55 rotations. At speeds of 11 to 17 revolutions per minute, one cycle lasts 3.14'' to 5.00'' minutes.

With a deep clean two cleaning cycles are usually run one straight after the other in order to remove even the larger deposits that are difficult to shift. Usually only one cleaning cycle is required for one intermediate clean, thereby halving the cleaning time, the amount of water required and the volume of waste water.



Before cleaning



After cleaning

C. Comparison of the advantages and disadvantages

The cleaning process with automatically rotating high pressure heads has four significant advantages when compared with manual cleaning using a high pressure lance:

- + The time required by the employee to perform the manual clean and the corresponding staff costs are largely eliminated. With a deep clean instead of 50 to 60 minutes cleaning time, a maximum of 5 minutes is required to check the cleaning results.
- + An automatic cleaning process with multiple spray heads and two nozzles per head ensures excellent cleaning results in significantly less time than a manual cleaning process. An automatic clean requires about 5 minutes per cleaning cycle, a deep clean requires 10 minutes (plus 5 minutes for checking the results) compared with 50 to 60 minutes for a manual clean. It goes without saying that this also reduces the downtime of the system accordingly.
- + Thanks to the shorter cleaning time and the mechanically defined guidance of the jets, significantly less water is consumed despite having more spray heads and nozzles than in a manual clean. This reduces not only the cost of clean water, but by the same token the disposal costs for waste water. Results from experience show that half the water used for a manual clean is needed in an automatic cleaning process.
- + 4) The automatic cleaning of the mixer is done with the lid closed. This prevents the surrounding area being splashed or sprayed with the dirty water from the mixer. Cleaning with automatically rotating high pressure spray heads saves on the working hours and labour costs, reduces the cleaning time and downtime of the mixer, and it reduces the volume and cost of clean and waste water. Furthermore, it minimises the contamination of the area surrounding the mixer from any splashes.

The following table provides a financial evaluation of the economic benefits for 2 Deep Cleans per working day, on the basis of an example. The results may differ in specific cases depending on the labour costs, hourly rates of the mixer and the costs for the supply and disposal of the water:

Category	Quantity	Saving	Cost rate	Savings
Labour costs	2	50 – 5 Minutes	17,50 EUR / hr	26,50
Downtime costs	2	50 –15 Minutes	45,00 EUR / hr	52,50
Water consumption	2	1 – 0,5 m3	1,5 EUR / m3	1,50
Disposal of waste water	2	1 – 0,5 m3	2,0 EUR / m3	2,00

In this example, there is a total saving of 228 Euros per day.

The economic benefits of an automatic cleaning process are further enhanced if in addition to the two deep cleans per day, an intermediate clean is also performed when the batch is changed.

The following example shows the savings with 2 intermediate cleans per day:

Category	Quantity	Saving	Cost rate	Savings
Labour costs	2	25 Minutes	17,50 EUR / hr	14,58
Downtime costs	2	25 –5 Minutes	45,00 EUR / hr	30,00
Water consumption	2	0,5 – 0,25 m3	1,5 EUR / m3	0,75
Disposal of waste water	2	0,5 – 0,25 m3	2,0 EUR / m3	1,00

In total (2 deep cleans plus 2 intermediate cleans per day) there is a daily saving of 128 Euros from these data. Working off the basis of 250 working days per year, this equates to a saving of 32'000 Euros per year.

Any advantages gained through an increase in the operational readiness and service life of the mixer and an improvement in the quality of the manufactured product have not been taken into account here.

D. Summary

The automatic internal cleaning of containers is a proven technique that has been relied upon for many years to carry out demanding cleaning tasks both effectively and efficiently. The material properties of cement are ideal for high pressure cleaning, since the high physical impact force is very effective in breaking up any contamination that is firmly fixed on the walls of the mixer and the mixing mechanism. This is especially true if parts of the material have dried out on the surface.

The automatic cleaning of upright mixers offers not only undeniable time and cost advantages versus the manual cleaning still widely practised today, it also ensures that the cleaning quality is consistently high, which as a result impacts positively on the quality of the manufactured products, as well as the operational readiness and the wear and tear of the mixer.

Even if the mixer was purchased without an automatic cleaning system, one can still be installed in most cases. Many manufacturers of mixers already incorporate the necessary mounting holes in their equipment.



E. Next steps

If you use an upright mixer and think that the advantages of an automatic cleaning system as described here may be beneficial for your company, please first check to see whether the mounting holes for high pressure spray heads are already incorporated in the mixer's lid. If they are, you can draw up a detailed plan, which shows the required design of the cleaning system (number of spray heads, performance of the pump assembly, etc.). On this basis, we can draw up an offer, which is a prerequisite for an economic calculation using the specific data of your company. In this way you will have a reliable basis for making technical and economic decisions.

If you are planning to buy a new upright mixer, it is always worthwhile including the option of an automatic cleaning system in your considerations. The economic calculations can then follow as described above.

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