Article

19 Nov

Predictive model for inspections reduces maintenance costs and the risk of contamination in tanks and spray dryers.

label: Technology & Engineering

For subscribers

Food producers are increasingly having their tanks and spray dryers inspected for defects. This is because defects can harbour microorganisms that contaminate products. But when and how often does a tank have to be inspected? A predictive model helps in planning this correctly. A good inspection plan makes for a safer product and substantial cost savings.

In the food industry, a great deal of equipment is made of stainless steel (SS), including tanks and spray dryers. It is strong, easy to clean and resistant to corrosion. However, process conditions bring about mechanical and chemical stresses, through which, over time, corrosion and cracks also occur in SS. If these small defects are not detected and rectified in time, this can lead to damage and ultimately even leakage. However, in a first stage, in the cavities of the indentations and cracks (figure 1) microorganisms already accumulate and grow, which can result in contamination of the product.

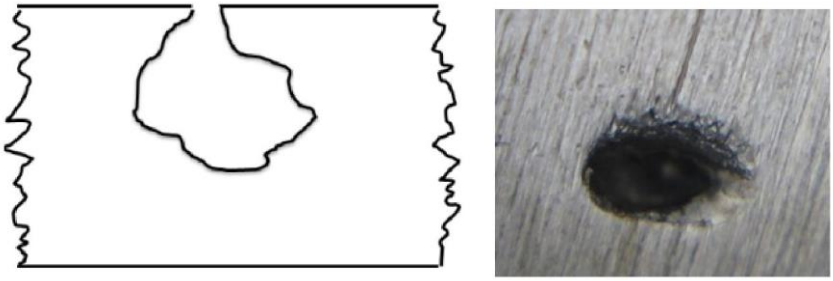

Fig. 1 Cavities in which microorganisms (biofilm) can develop

Defects in tanks, an often still unknown and underestimated risk

Marcel Wilmink, Bactoforce

Marcel Wilmink of Bactoforce Benelux BV explains that his organization is concerned with controlling microbiological risks. Bactoforce has already been inspecting tanks and spray dryers for twenty-five years. They are happy to share the knowledge that has been acquired with the food industry.

Wilmink: "Tank inspections are not obligatory, but the production of a safe product certainly is. A well-operating HACCP system therefore also includes an assessment of the specific risks of the product that is stored and dried in tanks. Some examples are raw milk, beer, drinks, fermented products, ingredients or baby food.

Non-alcoholic beer, for example, is particularly sensitive as the natural preservation by alcohol is missing. According to recent findings, however, bacteriophages can also survive in fermentation tank defects and slow down, or even completely stop, the fermentation of cheese. Intact tanks are therefore very important."

The product risks, in combination with the condition of the tank or dryer, form the basis of an inspection plan. Wilmink: "We estimate that quite a lot of dryers (85 percent) and tanks (30 percent) are already being inspected according to a plan. Nevertheless, we carry out many ad hoc inspections for *trouble-shooting*. Many plans are static whereas conditions change. Customers regularly ask us to help when setting up or optimizing the inspection plan. A well set-up plan contributes to product safety and considerable cost control."

Identifying defects with an integrity inspection

The cavities in defective areas can harbour microorganisms, or do so in time. All defects must therefore be located and eliminated. Wilmink explains how his organization proceeds: "Cracks, corrosion, welding defects and scratches are some of the seven different surface metal defects which we have classified for reporting and training purposes. We rapidly and effectively detect these defects with a 100 percent surface UV dye penetrant test and a microscope camera. The composition of the penetrant is adapted for use in the food industry. Among other things, we visually inspect the condition of the packaging, agitators and sight glasses, and with UV light, we locate residue of the penetrant.

We mark all defects and digitally determine the type and position of the defect for reporting and data analysis. Welders and fitters can then use our rope access materials and safely carry out repairs. The total time of inspection and some repairs is four hours for a tank and eight to twelve hours for a dryer. As a repair does not eliminate the cause of defect formation, we always recommend carrying out a *root cause* analysis."

Also read:
Looking for cracks (2009) →

Predictive model for the right inspection interval

When establishing and optimizing an inspection plan, food companies seek a balance between the cost of inspections and the planned *downtime,* versus risks of higher costs and unwanted *downtime,* misfortune and contaminated product. Wilmink says that in discussions with customers about an inspection plan, the so-called bathtub model is used (figure 2).

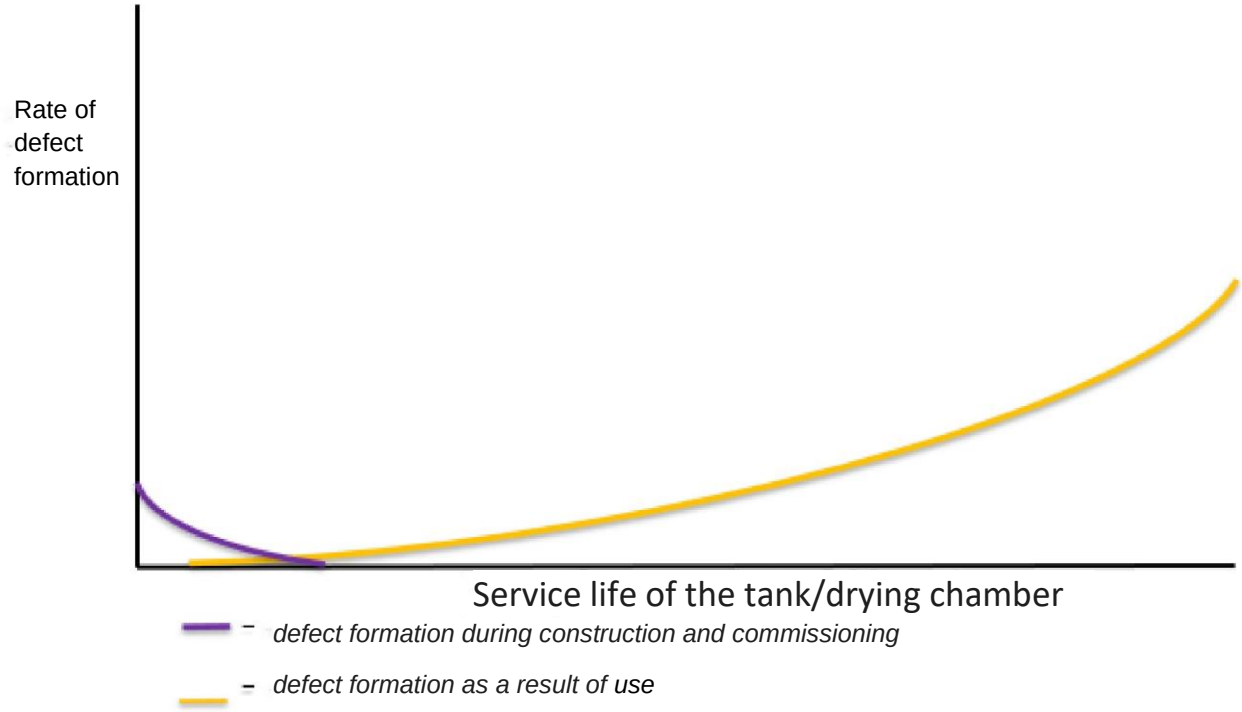

Fig. 2 Bathtub model

"The bathtub model illustrates the speed with which defects occur. The typical bathtub shape is determined by two lines. The purple line shows the individual defects such as grooves, scratches and welding defects that occur during construction or during the transporting and setting up of the new installation. The yellow line illustrates the rate of occurrence of previously described defects through mechanical and chemical stressing during use."

If an installation is not repaired, the occurrence of defects runs in accordance with the red line in figure 3. At the time of an inspection and hygienic maintenance (a dot in figure 3), the number of defects and the risk of contamination are returned to zero and the lifespan of the installation is thereby often prolonged. The first inspection is the validation of the new installation (blue dot in figure 3). Production can thus start safely and without defects.

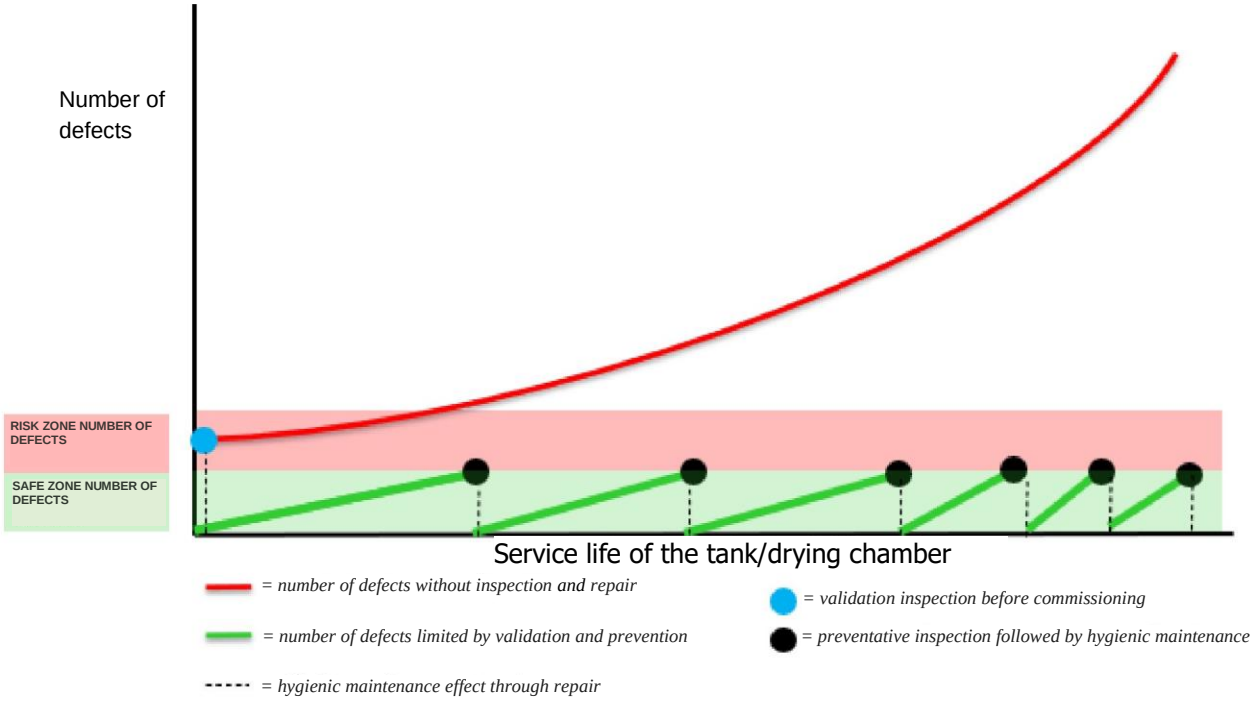

Fig. 3. Evolution of the number of defects with and without inspection and repair moments

Generally speaking, in the first years of use hardly any defects should occur. Inspections are then advisable in order to detect undesirable process parameters in good time so as to prevent worsening of scratches and corrosion. With each subsequent inspection (the black dot in figure 3), the number of detects is returned to zero. The time for inspection is when the number of defects (green line in figure 3) reaches the symbolic critical zone (red zone in figure 3). As the tank ages, the green line climbs more steeply and the critical boundary is reached more quickly. Inspections then follow on from each other more rapidly.

The microbiological sensitivity of a product and the safety net of quality control are also expressed in the model and are illustrated by the varying height of the green zone. Symbolically, in the case of a sensitive product (figure 4) the critical number of defects is lower and the interval between inspections shorter.

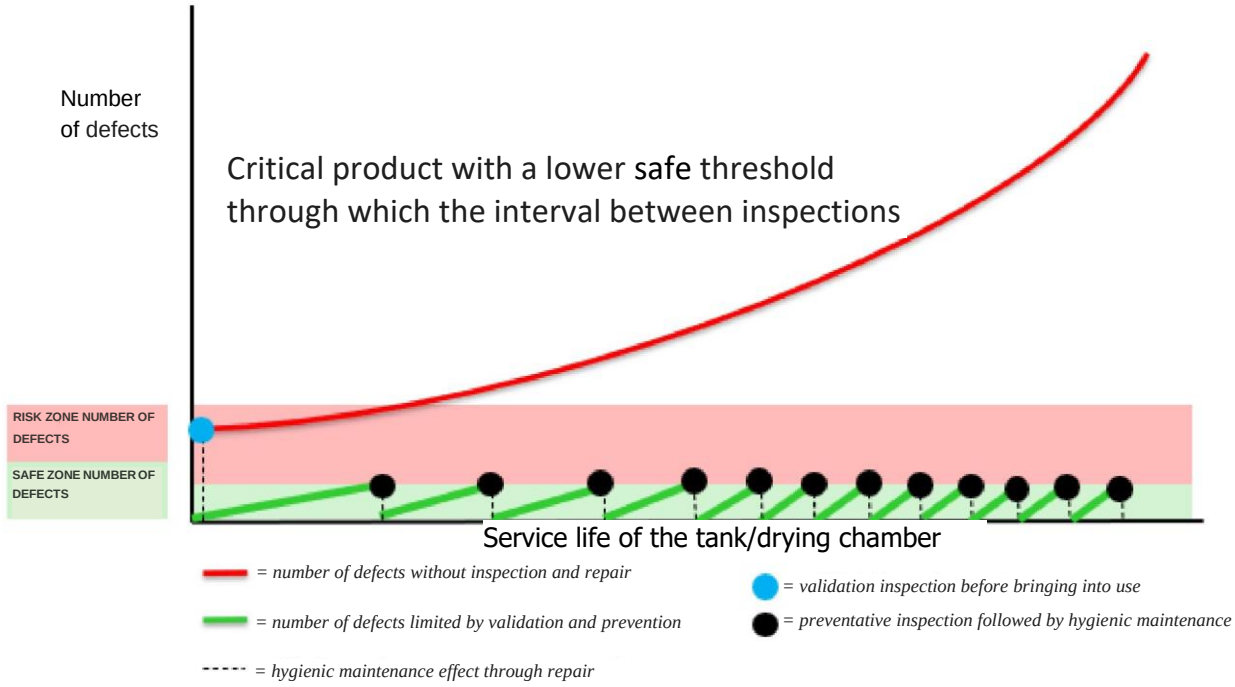

Fig. 4 Microbiologically more sensitive product with a limited safe zone and shorter inspection interval.

Together, the blue and black dots form the basis of the dynamic inspection plan. Bactoforce advises evaluating the plan after each inspection and also making use of available microbiological results.

Determining the technical age of the installation.

"Customers sometimes ask us to come up with a plan for an installation for which all details about previous use and age are missing," says Wilmink. "What growth rings are for the age of tree, the number and, above all, the type of defects, are for the technical age of an installation. This is because as an installation gets older, other surface metal defects occur (figure 5). If we divide the life cycle of a tank into four phases we see typical defects occurring in each phase."

"With the results of at least two inspections and repair of defects, we know the number and type of defects and also what has happened in the intervening period. If we superimpose the results on the bathtub model we can see which phase the tank is in. This is the starting point for an inspection plan."

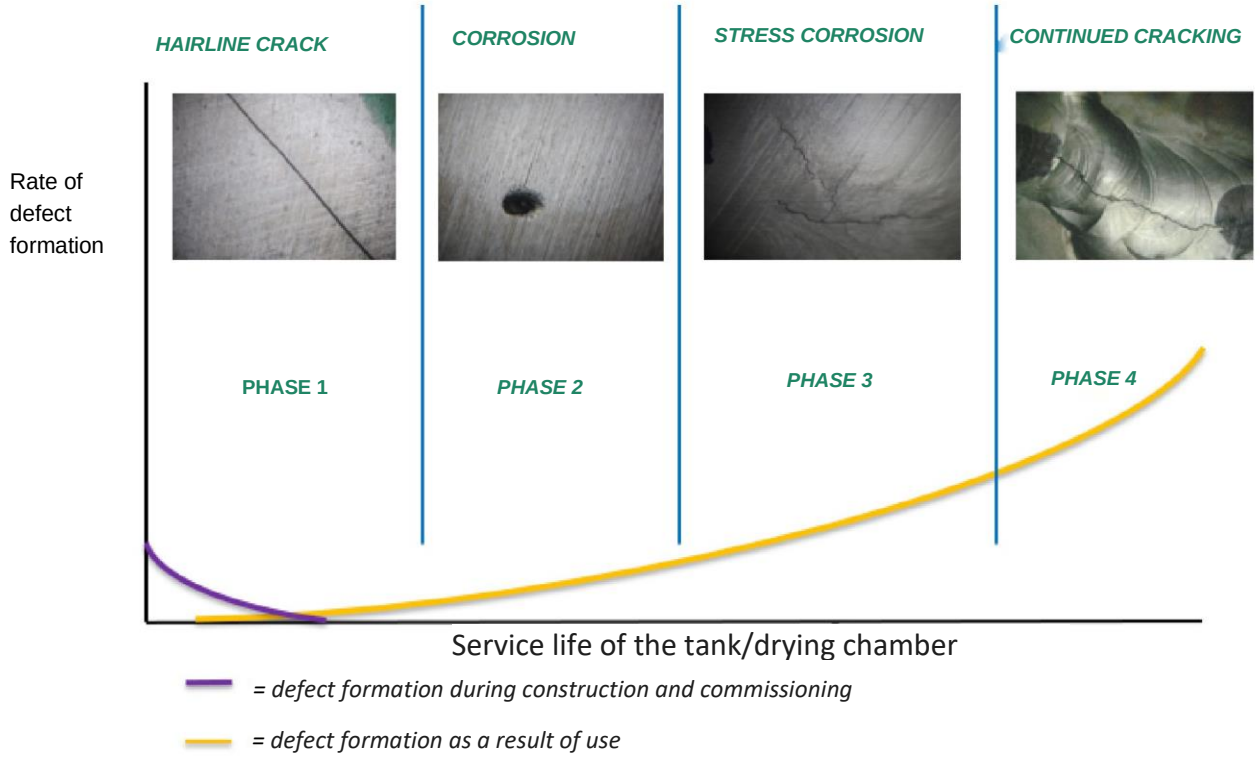

Fig. 5 Different types of defect that dominate in a phase

Stress corrosion is a branched crack occurring through repetitive forces (metal fatigue). *Continued cracking* occurs if a previous repair fails. The durability of stress corrosion repair, in particular, is frequently limited as the material is already dated, and it is often not possible to use *backing gas* during welding.

Considerable costs saving possible through replacing installations

If repairing a tank or dryer no longer possible or cost-effective, it is written off. The process of replacement often lasts at least two years. If this process is only started when the installation is written off, bridging this period is often difficult and costly. The technical age can therefore function as a good signal for an imminent write-off. Wilmink adds: "For a number of different customers we fulfil the signalling role in that we manually determine the technical lifespan. Through this, various tanks and dryers have been replaced in recent years. We are working on an algorithm in which a defect has its own severity factors. In the future, we want to be able to show the location manager at a glance the current status of the time for inspection, technical age and urgency of replacement.

First published by Redactie VMT on 19 Nov. 2020

Latest update 23 Nov.