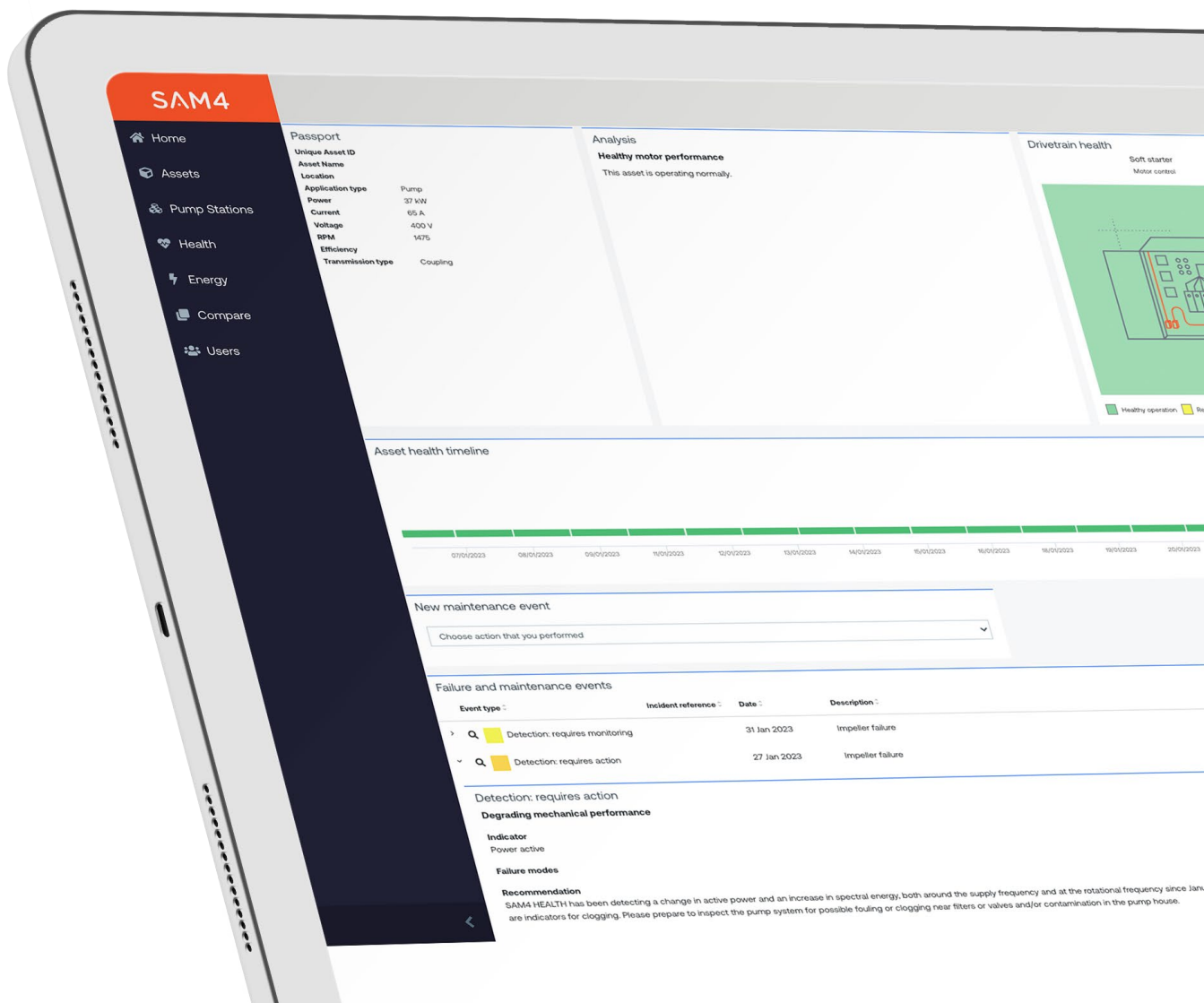


# SAM4 automated clogging detection feature

Learn how advanced analytics can help water companies detect pump clogging remotely, preventing pollution events and leading to optimized maintenance planning



# The impact of clogged pumps

Pump clogging presents one of the biggest challenges to the water industry. In pump stations and sewage treatment plants removing the blockages has become part of the weekly routine. Ragging from inappropriate material such as baby wipes and other sanitary and hygiene products is the major cause of clogging. Other materials such as wood and silt are also causes. Clogging can lead to pump overloading and tripping, which in turn can lead to pollution events, a reduction in pump lifetime or impact on delivery of services to customers. Pollution events can have serious financial and environmental impact, especially if impacting high-priority nature sites, and can cause serious public health issues and reputational damage. From an operational perspective, clogging adds to business costs. It creates reactive visits to pump stations to deal with clogging issues, which incurs increased costs related to more man hours, fuel costs and associated emissions related to transport. It also increases emergency maintenance costs. With clogging reducing pump lifetime, this has a negative impact on capital expenditure for water companies, having to replace assets more frequently. Clogged pumps also negatively impact delivery of services and increase energy consumption as even partially clogged pumps use energy less efficiently.



# Standard strategies for dealing with clogging

Managing and preventing blockages represents a significant operational challenge in optimizing maintenance activities for water and wastewater companies. Currently, thousands of visits are undertaken to sewage pumping stations across wastewater networks every year to perform inspections. Cyclical scheduled visits to perform preventative inspections are one of the principal methods of this.

The other side consists of reactive visits mainly due to tripped pumps or physical indications of a flooding/overflow incident. These can come either from the public reporting of overflow incidents or from well-level sensors which can produce hundreds of alarms and overwhelm operational teams simply due to heavy rainfall. This strategy incurs significant financial costs as well as emissions related to transport, especially when considering that the majority of pumps inspected are in good working order. It also incurs the costs associated with shorter pump lifetime and failures which lead to less efficient delivery of services and increased operating and capital expenditure. To reduce pollution events and associated costs within this strategy would mean increasing cyclical visits which would further increase costs. Another option would be to find a way to reduce reactive visits or the impact of them. The optimal maintenance strategy to decrease the number of cyclical and reactive pump visits and at the same time reduce pollution events would be to transition to a remote predictive/proactive maintenance strategy.



## FEATURE OVERVIEW

# SAM4 Health automated clogging detection feature

Samotics' SAM4 Health asset monitoring solution includes an automated clogging detection feature. The clogging detection feature has been developed with, and successfully used by, the water industry to detect developing cloggings in real time. This is enabling the industry to optimize maintenance planning, reducing the need for cyclical visits and potential pollution risk. The feature holds applicability within all water companies' predictive maintenance strategies.

SAM4 Health's automated clogging detection feature provides the water industry with an automated remote monitoring solution. This removes the need for scheduled cyclical pump visits, saves on associated costs and allows water companies to optimize maintenance planning. The feature alerts to clogging by analyzing electrical signals from sensors located in the pumps' motor control cabinet. This provides for easy installation as sensors do not need to be physically attached to the asset itself. It makes it ideal for monitoring equipment situated in challenging operating environments such as submersed pumps.

Remote real-time detection allows for corrective actions to be taken before the situation has more serious implications associated with a completely clogged or tripped pump. This further reduces costs and the risk of pollution events. It also mitigates the need to employ a more capital intensive strategy such as improved shredder/grinder technologies. Alerts of instantaneous clogging further allow water companies to perform maintenance actions as soon as possible to further reduce the risk of a pollution event from occurring.

One major advantage that comes with the automated clogging feature is that it is just one feature of the Samotics SAM4 Health solution. Other features of SAM4 Health detect additional issues with asset health e.g. impeller wear, which can be the result of previous clogging or cause the next clogging, and process optimization. This helps in reducing downtime and associated costs, extending machine lifetime and reducing the necessity for full equipment replacement.

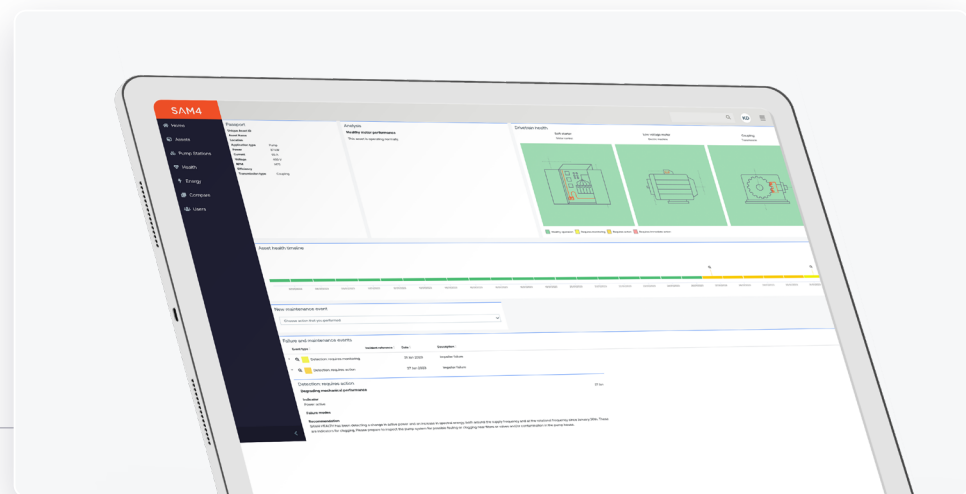
# How SAM4 Health's automated clogging detection feature works

SAM4 Health and all of its incorporated features work on the principle of electrical signature analysis (ESA). The system analyzes electrical signals via sensors located in the motor control cabinet which perform high-frequency data capture. Developing electrical and mechanical failures influence the electromagnetic field surrounding an electrical motor: not only failures in the electrical motor itself but also in the asset (e.g. pump) it is driving. Each specific fault influences the electromagnetic field in a specific way. This can be picked up within the electrical signals following extensive processing, transformation and analytics on Samotics' AI platform.

The automated clogging feature uses a combination of indicators to get to highly accurate predictions and results. Once a blockage starts to manifest, the technology is able to pick up slight changes in power usage, with signs of mechanical unbalance and cavitation being present in parallel. Furthermore, Samotics can utilize its extensive experience in the detection of developing pump failures in the water industry. This experience enabled Samotics' data scientists to create the clogging feature based on previous detections of pump clogging.

Figure 1

The automated clogging detection feature is just one of the features built into Samotics' SAM4 Health solution.



The feature goes beyond simply alerting that a clogging incident is developing. It indicates the severity and nature of the pump blockage and where the blockage is occurring (inside or outside the pump).

It also takes into account the status of the whole pump station where multiple pumps are normally in situ. This helps the clogging feature to determine the severity of the situation for the whole station and thereafter alert the customer to what action needs to be taken. This could either be continued monitoring of the pump station, planning in a maintenance visit, or an emergency maintenance response. Once a clogging incident has been cleared by a customer, additional SAM4 Health features can determine if any asset health issues have been caused such as impeller damage or unbalance.

Detecting clogging in its early stages in real time enables water companies to move toward a proactive maintenance strategy. It reduces the number of pollution events occurring, which reduces associated costs, and reduces the severity of maintenance activities that need to be taken. Catching such issues early helps to extend machine lifetime and helps pumps run more efficiently. With alerts only being sent on pumps with performance/health issues, by definition the remaining pumps are in a healthy state of operation. This mitigates the need and costs for cyclical visits to check on pump status, though of course the status of any healthy or unhealthy pump can be continuously checked in the SAM4 Health dashboard.

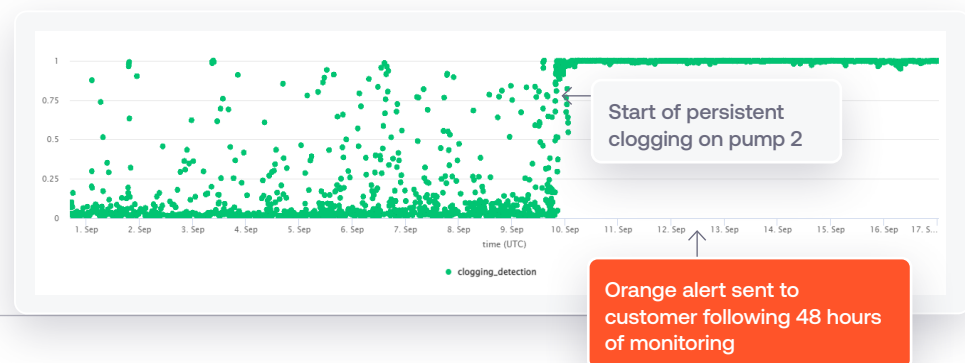
## CLOGGING FEATURE IN ACTION

# Early alert on clogging incident developing across two pumps

At a sewage pumping station two co-located pumps operate in an alternating pattern to meet required demand and provide system redundancy. One night one of the pumps (pump 2) displayed characteristics of clogging. This could be seen in Figure 2 below where the clogging scores remained continuously high following the start of the incident.

**Figure 2**

From the generated data, you can clearly see the start of a clogging incident during the night of 9-10 September 2022. Hereafter, the clogging score remained at the highest level of clogging indication (around 1.0) until a maintenance crew cleared the blockage on 20 September.



With one other working pump at the station, this did not create an emergency response situation at the time. Monitoring of the situation continued for 48 hours to observe if the blockage would clear itself in this timeframe or alternatively generate advice as to when a site visit would be necessary. With no improvement seen at the end of this monitoring period, an orange alert was generated and sent to the customer indicating a clogging incident at the pump. The alert stated that same-day action was not required and that the situation could be resolved in the following week without impacting pump station operations.

Approximately one week later, data also indicated signs of developing clogging on the other pump at the station (pump 1). With two clogged pumps this did create an emergency response situation due to an increased risk of a pollution event. As a result, a red alert notification was sent to the customer.

A maintenance team was immediately sent to the site and lifted both pumps out of the pumping station. They found that both pumps were indeed partially blocked confirming the detections by SAM4 Health and its clogging feature. After the blockages were cleared and the pumps were put back in operation, the clogging scores and other supporting metrics returned to healthy operating levels. This can be seen in Figure 3 below.

**Figure 3**

You can clearly see the resolution of the clogging incident on 20 September 2022. Once the maintenance crew removed the blockages, the continuously high clogging scores on pump 2 and the signs of developing clogging on pump 1 dissipated, reverting to healthy clogging score levels.



The SAM4 Health automated clogging detection feature successfully pinpointed the developing issues. It provided continuous insight into the severity of the situation and alerted to when action needed to be taken. **This enabled the customer to optimize maintenance planning and prevent a potential pollution event from occurring.**

## Conclusion

Clogging has a major impact on the water industry. It can culminate in flooding and pollution events which can have significant environmental and financial consequences. It can also lead to a reduction of pump lifetime, reducing the efficiency of how pumps operate and impacting the delivery of services to customers. This further negatively impacts the financial health of water companies.

SAM4 Health's automated clogging detection feature can greatly reduce the environmental impact and associated costs currently experienced by water companies in relation to clogging. It mitigates the need for cyclical inspections and reduces the impact and cost of reactive maintenance, helping companies move toward a more proactive strategy. It does this by alerting in real time which pumps have clogging issues either developing (ragging) or instantaneous, and by that same token which pumps are operating healthily.

It also alerts to the severity of incidents taking into account the status of a pump station as a whole. Water companies can use these alerts to optimize maintenance planning while at the same time reducing pollution events and operating costs. This will help water companies to develop more efficient operations and more resilient networks on the path to net zero. By using SAM4 Health and its full suite of tools and services, water companies further benefit from a system which can assist in asset health monitoring and process optimization.

# Interested?

Would you like to get to know more about how SAM4 Health works and whether it could be of value to your operations? Do not hesitate to reach out.

## Contact

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