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## Parameters for Effective Service Checking costs and performance in wastewater treatment

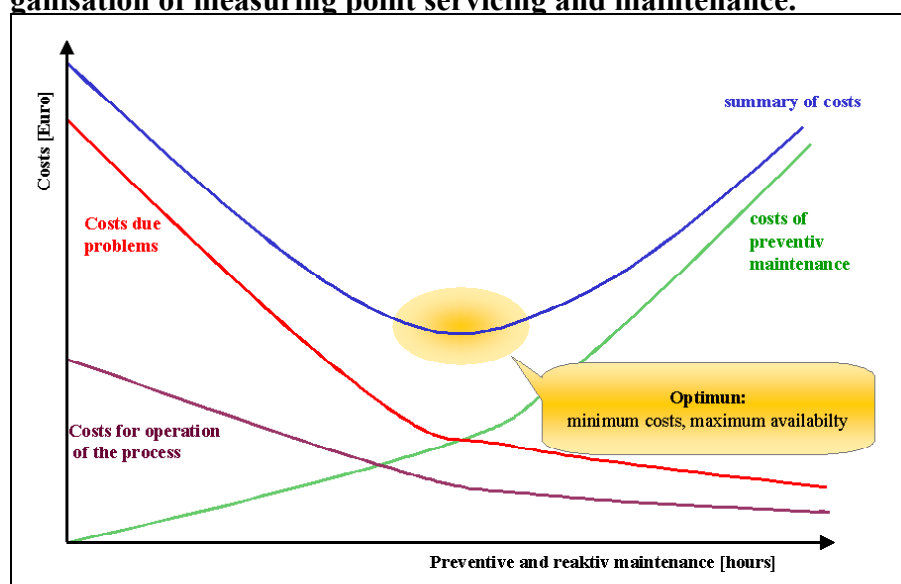
Endress + Hauser GmbH + Co. KG

Around 60 measuring instruments are in use in a modern wastewater treatment plant. This is a number which can greatly increase depending on the size of the plant and the type of wastewater. The measuring instruments record various parameters from the areas of level and flow etc., but mainly from the area of analysis. The majority are installed in the water and sludge treatment sections.

Using perfectly-adapted instrumentation, three tasks can be tracked in parallel at the wastewater treatment plant: adherence to limit values specified by law, smooth running of the treatment process and – in conjunction with this – the optimisation of the process. In this way, measuring devices can reduce operating costs both directly and indirectly.

Optimising the operating costs, however, does not only mean having an optimum treatment process. Working effectively also means to optimise the operation of each individual measuring instrument – all the more, considering the cost of a measuring point is comprised of only 25% investment costs (planning, purchasing, commissioning) but 75% general operating costs, preventive and reactive maintenance costs: Obviously, there is great potential for cost reduction over the entire life cycle of an instrument.

**What counts is not only the right instrument in the right place but also use-focused organisation of measuring point servicing and maintenance.**



**Figure 1: Cost of ownership and maintenance seen as a whole: The optimum is achieved from the best relationship between costs and availability.**



The operative word here, however, is not service or maintenance. The central question is: what is “use-focused”? Maximum preventive maintenance of all devices may have a positive effect on the operating costs but causes service and maintenance costs to shoot up out of proportion. Optimum preventive maintenance, on the other hand, weighs risk and effort against one another.

### **“Use-focused” organisation of servicing and maintenance is a function of the process relevance and maintenance intensity level of a measuring point.**

Let us first take a look at relevance in the process: A group comprised of workers in research, service, operating staff and instrumentation specialists examined typical measuring points of a medium-sized wastewater treatment plant (with nitrogen elimination) in view of these factors. A catalogue of criteria was drawn up to categorise the priority of a measuring point. The significance of individual criteria was illustrated in a points system. The “criteria weighting” table shows that, besides legal stipulations, the functionality of the entire plant, the availability of the sub-process and the realisation of substitution parameters also had an effect on the evaluation.

<b>Weighting of view points based on the entire wastewater treatment plant</b>	<b>Points</b>
Stipulated measuring point, continuous	20
Parameter used for calculating discharge fees	2,8
Quality control in the lab to EKVO / SÜV (German regulations for monitoring wastewater systems) stipulated	0,8
Potential for efficiency optimisation	2
Potential for cost optimisation	2,8
Functionality of entire plant	5
Availability of sub-process	3,6
Substitution parameter is available	3

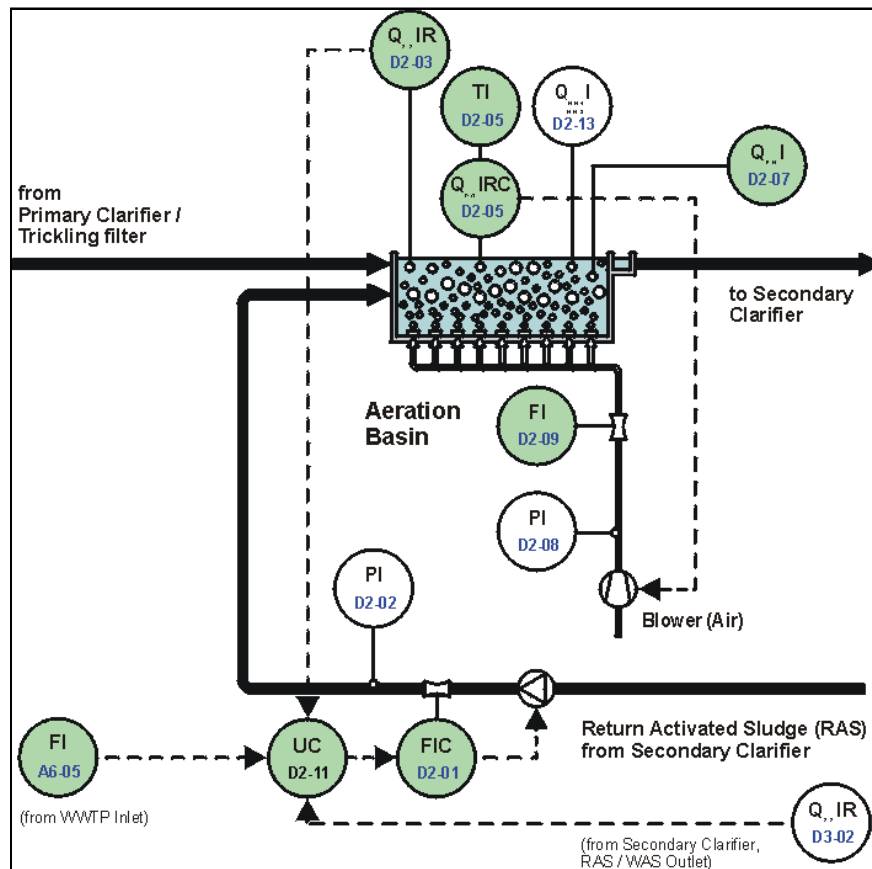
**Table 1: Eight criteria form the basis for evaluating a measuring point. The score indicates their relevance and thus the multiplication factor for the evaluation.**

### **63 standard measuring points**

...were then examined to see to what extent the specified criteria applied. Depending on the relevance for the measuring point in question, the criterion score was multiplied by 0,1 to 2. This gave a total score for each measuring point which describes its place in a priority list.

### **The result**

Oxygen measurement in the activated sludge basin achieved the highest score in wastewater treatment, and temperature measurement at the digester obtained the highest score in sludge treatment.



According to law	no	yes		Score
Continuous measurement is stipulated		x		40
Measured value is a parameter used for calculating discharge fees	x			0
Quality control in the lab to EKVO / SÜV (German regulations for monitoring wastewater systems) stipulated	n			0
Measuring point for	no effect	favourable	essential	
Efficiency optimisation			x	4
Cost optimisation			x	5.6
Functionality of entire plant			x	10
Availability of sub-process			x	7.2
Substitution parameter is	needless	easy	difficult	
				3
			Overall score	69.8

**Figure 2: Oxygen measurement to control aeration. Evaluation of oxygen measurement in the activated sludge basin: Like all other measuring points displayed in green, it is typical for a wastewater treatment plant of the type described above and achieves a total score of 69.8.**



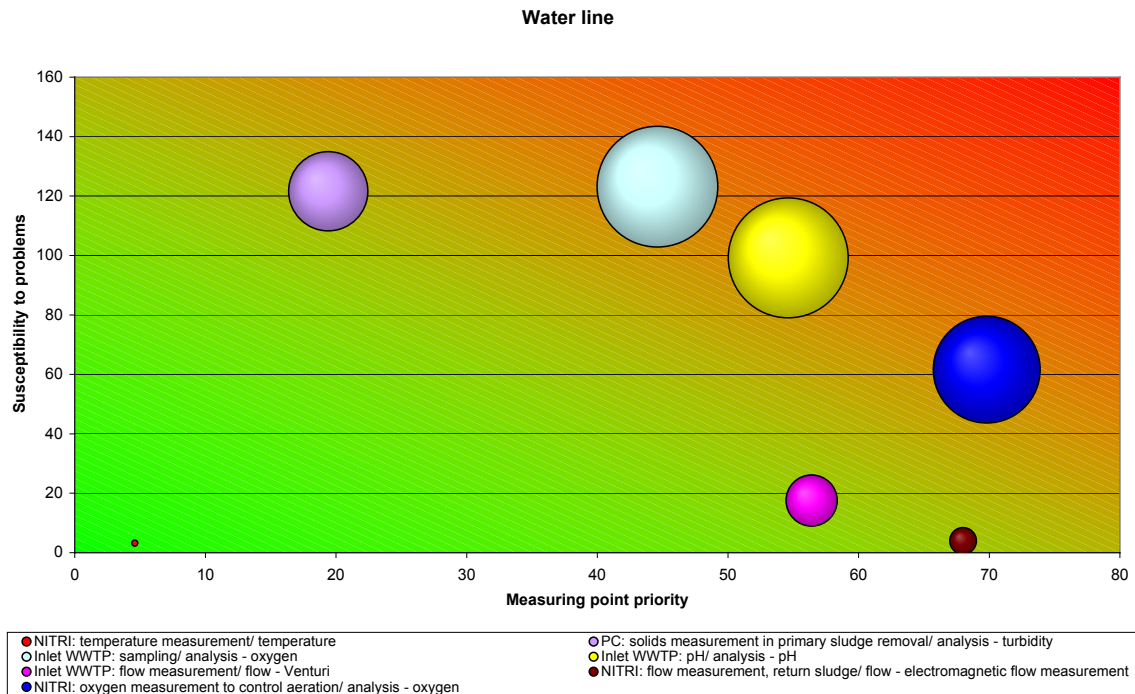
After process relevance, the measuring points were then assessed for their maintenance intensity. In line with the first criteria list, a second list was created and also weighted by means of a points system. The measurement methods used served as a basis. Experience shows that the maintenance effort required for flow, level and pressure measurement is considered to be significantly lower than the effort for analysis parameters such as pH and oxygen.

Factors for calculating the intensity of maintenance based on the type of measurement (total 100)	Points
Analyzers	21
Analysis - oxygen	15,4
Analysis - turbidity	15,2
Analysis - pH	12,4
Analysis - nitrate probe	5,4
Flow - Venturi	4,4
Flow - thermal	4,2
Analysis - conductivity	3,6
Level - ultrasonic	3,2
Level - capacitive / conductive	3,2
Level - hydrostatic	3
Flow - orifice plate (gas)	2,8
Pressure	2,6
Flow - electromagnetic flow measurement	2
Temperature	1,6

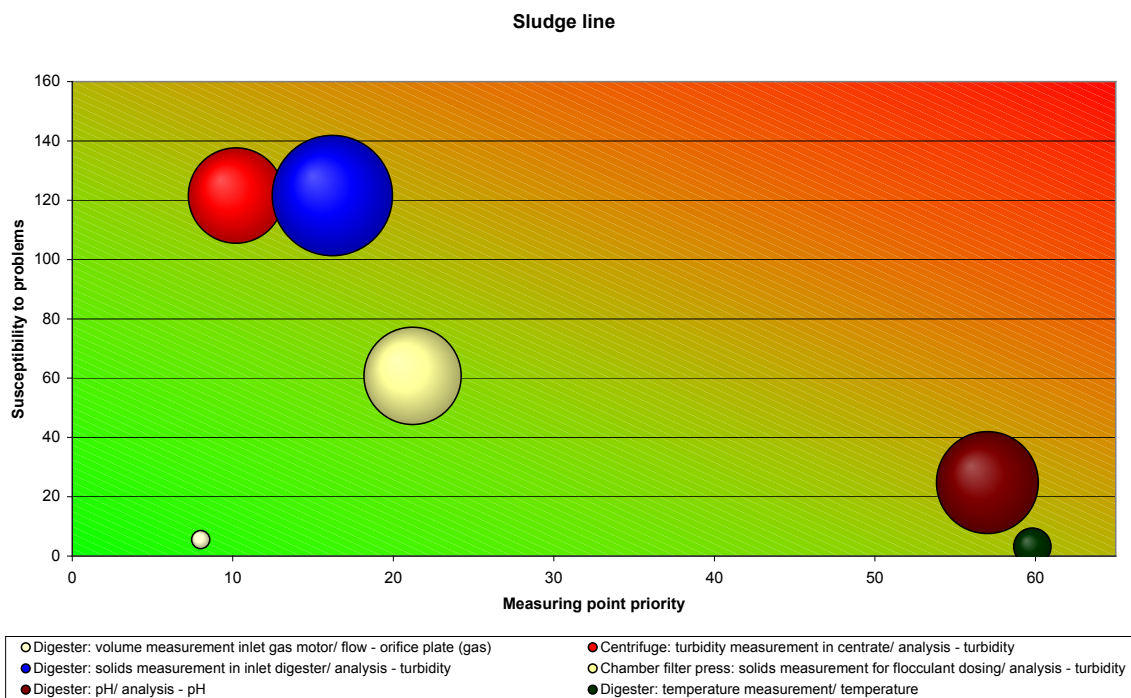
**Table 2: 15 measurement methods/parameters and their weighting with regard to maintenance intensity**

For maintenance intensity, a process in line with the first evaluation was selected for all 63 measuring points: Depending on the installation and environmental conditions, they were assigned a value between 1 and 4 which was then multiplied by the specified score.

The result: In wastewater treatment, sampling in the inlet is the measuring point requiring the greatest amount of maintenance due to the difficult wastewater; turbidity measurement in the inlet to the digester was identified as the most problematic measuring point in sludge treatment.



**Figure 3: Water line. Some examples of measuring points. Red means high priority, green means low priority.**



**Figure 4: Sludge line. Some examples of measuring points. Red means high priority, green means low priority.**



There are no measuring devices with high priority in the sludge line. The reason: sludge treatment failure does not represent an acute danger to the purification process. The complete graphic is available on request. Your local Endress+Hauser partner will be happy to assist you.

## Comparative display

...of the measuring points shows how a service concept can be optimised with the results:

- The measuring points in the green area are generally low priority. A reaction time of one to two weeks suffices here.
- A service contract for preventive maintenance certainly makes sense in the central section.
- Intensive servicing and preventive maintenance is absolutely essential for measuring points in the red section. In addition, typical spare parts should be in storage and a regulated service contract and an emergency concept should be discussed with the manufacturer.

The results of this study are based on experience and prevailing standards. They cannot be applied on a 1:1 basis to every wastewater treatment plant as, for example, national legal specifications can shift the priority of a measuring point or the maintenance intensity of a certain measurement can be altered by climatic conditions. However, the method selected can be applied. Visually illustrating the measuring point priority and maintenance effort is an excellent aid when evaluating essential service concepts.

In addition to completely recording all the measuring points, the age and condition of the measuring instruments is also an important criterion when designing a service concept for existing plants.

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