

TREATMENT OF OIL AND HEAVY METAL CONTAMINATED WATER

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ABSTRACT

The presence of oil contaminated water in many industrial processes causes a need for the development of techniques to purify waste process water. Purified process water can be reused, which is an advantage from an ecological as well as a financial point of view.

Reuse of process water enables a reduction in water consumption, reduces the use of chemicals and results in less water that has to be disposed of. These factors will motivate companies to invest in equipment for purification of waste process water even if the flow rates are low.

TTM-produkter is a Swedish company based in Kalmar aiming at developing know-how and equipment for water treatment. The company is together with the University of Kalmar developing a modular system for purification of process- and wastewater. The system will be on a low investment level, easy to operate and therefore well suited for small and medium-sized companies.

The system will be tailored for a number of defined applications, easy to install and require almost no construction work on the building. A standard installation consists of a sludge and oil separator in polyethene placed on the floor, a hydrocyclone to remove particles and two filter cartridges filled with smart/selective adsorbents.

Until now about 30 installations of the system have been made in Sweden and Poland. The installations cover a wide range of different industries such as car and bus washes, car demolishing plants, laundry services and ceramic, metal and graphic workshops. The best results from an ecological as well as a financial point of view has been achieved in medium-sized operations with a low flow rate of waste process water, for example a plant where 1-5 buses are washed each day or a machine for washing spare parts at a car demolishing plant.

New environmental legislation and voluntary certification in accordance with ISO 14001 Environmental Management System not only forces but also motivates companies to invest in systems for treatment of waste process water even if the flow rates are low.

BACKGROUND

Legislation

Oil contaminated water is a problem in many different industries, for example harbours, oil depots, metal workshops, vehicle washing facilities and transportation terminals. The oils, which often contain heavy metals, affect the wastewater treatment plants negatively. Furthermore, the oils and heavy metals makes it unfeasible to use the sludge from the treatment plants as fertiliser, which would mean a recirculation of the organic substances and phosphates.

These factors have made the national and local environmental authorities to consider new guidelines. The most important of these are the following general guidelines from the National Environmental Protection Agency:

SN-AR 93:7	Oil harbors and oil depots
SN-AR 93:9	Degreasing of metals
SN-AR 96:1	Waste water from vehicle washing
SN-AR 97:5	Inorganic metal finishing
SN-AR 97:6	Metal industries waste and waste water treatment

(proposal)

In many municipalities the local environmental authorities together with the wastewater treatment agencies have set up general TLV for different substances in the water. The ambition is of course to apply the guidelines in the same way on all companies, but in reality the implementation of the rules varies depending on the size of the company. Small companies often lack the financial resources to fulfill the requirements.

The larger companies often create a need for improvement of the wastewater quality among the smaller ones. When the larger companies implement environmental management systems, replace chemical products or change production techniques, it affects their suppliers and customers. In some cases the smaller companies are forced to make changes, but just as often they are inspired and assisted by the larger ones to make improvements voluntarily.

The environmental awareness in general is improving with an increasing number of companies getting certified in accordance with ISO 14001. This has, in our opinion, a quicker positive effect on the environment than legislation. Voluntary actions also indicate an understanding and motivation that never can be achieved with legislation.

Unfortunately some environmentally labelled products are counterproductive, despite being environmentally friendly per se they have a negative effect on the environment. For example the new environmentally friendly detergents for degreasing in car washes create stable emulsions which can not be dealt with in a gravimetric oil separator. This is not the case with the old type of detergents that are based on hydrocarbons. As most car washing plants are equipped with gravimetric separators, a switch to the new detergents results in an increase in the amount of pollutants in the wastewater. It is probably possible to separate the emulsions with reversed osmosis or ultrafiltration, but these methods are very costly compared to gravimetric separation.

Financial limitations

It is hard to justify the purchase of an expensive water treatment system in small companies with small amounts of oil contaminated water. Furthermore, smaller companies often lack the manpower to operate and maintain an advanced purification system for wastewater.

A water treatment system for small companies must be easy to maintain and inexpensive to buy and operate. It is also an advantage if no chemicals are needed to make the system function. If the price is not too high, preferably below 50 000 SEK, the operating costs are low and the system is easy to operate, most companies will have the financial capacity and manpower to buy and run the system.

It is not unlikely that the system will pay off financially. In some cases companies pay 600 – 1 000 SEK/m³ for wastewater destruction or disposal, and if the water is recirculated instead these expenses are reduced.

Technical requirements for low-cost systems

In our view, purification of oil contaminated water should be based on many small steps put together in a system. Each step should be easy to understand and maintain so personnel with limited knowledge of water treatment and chemistry can operate the system. In many cases the system will be installed in an existing building and production line, so it is also an advantage if the system is easy to install and connect to plumbing and electrical systems.

When the production changes the purification system must change with it. Therefore the system must be flexible, with the possibility to move, add or deduct steps as the operations change.

With new production techniques, replacement of dangerous chemicals and a general reduction in the amount of chemicals used, the need for advanced purification systems will decrease. On the other hand there are many small sources of waste process water that have been overlooked but need to be treated in a purification system. These sources are often discovered during the environmental investigation when implementing an environmental management system.

As mentioned earlier, the wastewater from vehicle washing is an environmental problem identified and regulated by the authorities. There are, however, other areas that have not yet been regulated. An example is establishments selling, changing and storing tires. Tires are the dirtiest part on a car, but no general regulations exist for these facilities and the authorities do not inspect them. We believe that there are many other industries where it is yet to discover that water purification systems are needed.

TTM-produkter is developing a small modular water purification system, TTM PRECLEAN, that will cost about 70-75% less than existing systems based on ultrafilters or reversed osmosis. The purification will be sufficient for most applications although not as good as ultrafiltration or reversed osmosis. The fact that the performance is lower is in most cases outweighed by the difference in price, and the need for purification is also lower if the water is reused rather than led to the sewage system. Thanks to the module concept the system can be altered or expanded as the flow rates or need for purification changes.

TTM PRECLEAN

Existing installations

So far the TTM PRECLEAN system has been installed in a number of applications with low flow rates such as car and bus washes as well as metal-, ceramic- and graphic industries. In general and given the circumstances the results have been good, but there is a need to discuss the type and amount of chemicals used in the processes with the managements. In some cases even a discussion of the steps in the production process could be worthwhile in order to reduce contamination etc. It is also clear that know-how about water treatment and environmentally friendly production techniques must be supplied together with the purification equipment.

Analyses and assessments have been made for installations in metal industries where the process water is reused. The lifetime of the baths have been prolonged 5-10 times which indicates a large potential for cost reduction.

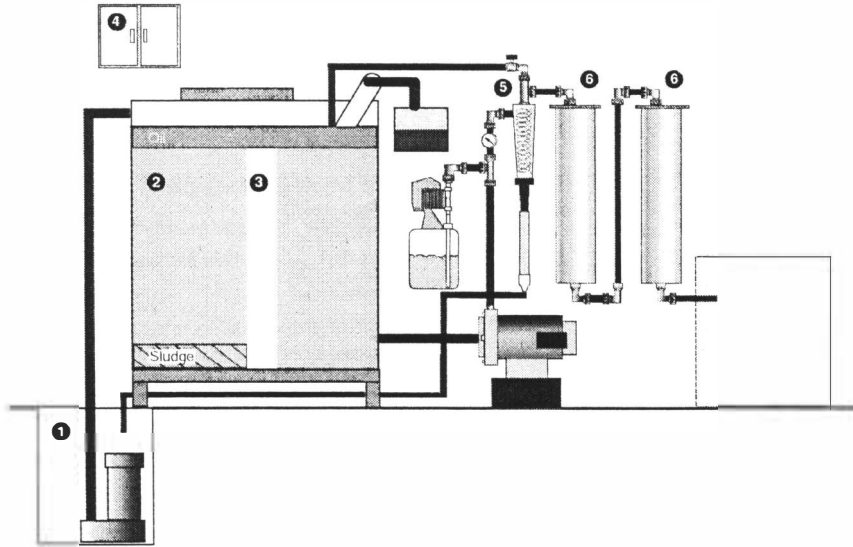
Installation costs

The system can be placed on the floor inside the building, construction work or digging is normally not necessary. This reduces the installation costs and makes it very flexible, it can easily be expanded, moved or even sold if the industry is closing. Installation indoors also enables easy inspection and maintenance as well as the possibility to take samples for analysing.

Design

A TTM Preclean system consists of the following basic modules:

A pump (1) feeds the sludge- and oil separation tank (2) with untreated water. In the tank solids will settle at the bottom while light oils and solvent will form a film on the surface. The oil separation is further enhanced with a coalescence unit (3) in the tank. The water flows over to a buffer tank. The buffer tank ensures that the rest of the system will have the right working conditions regarding flow rate and pressure. A control unit (4) controls a pump and when the water reaches the high level mark in the tank it starts and it runs until the level has reached the low-level mark. After the buffer tank the water passes a hydrocyclone (5) that uses centrifugal force to separate particles from the water. Then the water is led through two filters units (6) which are filled with adsorbents that are specially designed to adsorb different chemicals or chemical products. The filters also take care of any remaining particles in the water.



The system can be equipped with an optional skimmer that automatically removes the oil film from the surface.

A device that measures the flow rate, total amount of water and discharge to the sewage system is currently being developed. This unit also takes samples of the wastewater for analysing at given intervals, thereby making it easy to monitor the performance of the system.

The tanks are made of polyethene to keep the price and the weight as low as possible. Filter casings and hydrocyclone are made of stainless steel. The system operates at a pressure under the level where the regulations about pressure vessels apply.

Future development

The ongoing development of smart and selective adsorbents will make it easier to tailor systems to different applications while maintaining a low cost level. The development will, however, require a lot of testing of equipment and analysing of water samples. To make the development process cost-effective it is therefore necessary to continue the co-operation between TTM-produkter and the University of Kalmar that started in 1998.

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