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Bioremediation:

Wastewater treatment in small-scale installations

Diesel power plants are a versatile source of energy production. However, dealing with contaminants in the wastewater output can be problematical. Yael Barash of BioPetroClean Corp. and Yves Perrin of Maerkisches Werk of North America outline new developments in a method of bioremediation that can improve the efficiency of the wastewater treatment.

Diesel power plants have many advantages as a source of energy-production. Diesel power plants have a lower rate of fuel consumption (an estimated 25-35% less fuel consumed), higher level of energy efficiency, a better fuel safety rate, lower forced outage rates, and higher load factors among others. It is estimated that there are hundreds of thousands of diesel power plants worldwide, ranging in size and energy output, used for a variety of purposes. Diesel power plants serve a variety of functions, ranging from farming operations, mining operations, and military use, to small towns and isolated communities not serviced by normal power grids.

However, like any other oil consuming energy plant, there is still the issue of wastewater output. Most governments have very strict levels for contaminants in these wastewaters, and therefore monitor plants very closely.

There are many sources for diesel power plant wastewater output. Contaminated boiler waters, storm waters and run-off, oily waters from oil-water separation (reclamation processes), tank sludge, residue from oil maintenance changes, cooling water discharge, discharge water effluents, and storage tank contaminants are among the many potentially hazardous discharges that diesel power plants can produce. Hydrocarbons, TPH and COD, total suspended solids, oil and grease, and pH are among the most closely monitored levels in these discharges.

One of the best measures that can be taken to bring contaminant levels down below government standards is through bioremediation processes. Bioremediation is generally defined as a process that uses microorganisms to return an environment altered by contaminants to its original condition. This also clearly describes bioremediation applied to industrial wastewaters, as the process is known for its ability to return effectively these waters as close to their original (natural) state as is possible after processing.

BioPetroClean's Automated Chemostat Treatment (ACT) method of bioremediation is now being offered to diesel power plants, replacing the filtration process. ACT is a technology with a proven rate of efficiency and ease-of-use. A customised bacteria mixture is developed for each specific wastewater type needing to be cleaned. These bacteria come directly from nature, and require no alteration or genetic engineering. The concentration of bacteria is kept as minimal as possible, preventing any aggregate formation. Due to the low level of bacteria used, each bacterium performs as a single cell, increasing the surface area available for the process. This allows for a much higher quality of effluent. The process itself is a fully-automated, continuous flow that is maintained in a permanent homeostatic state, and can handle a variety of different waste capacities.

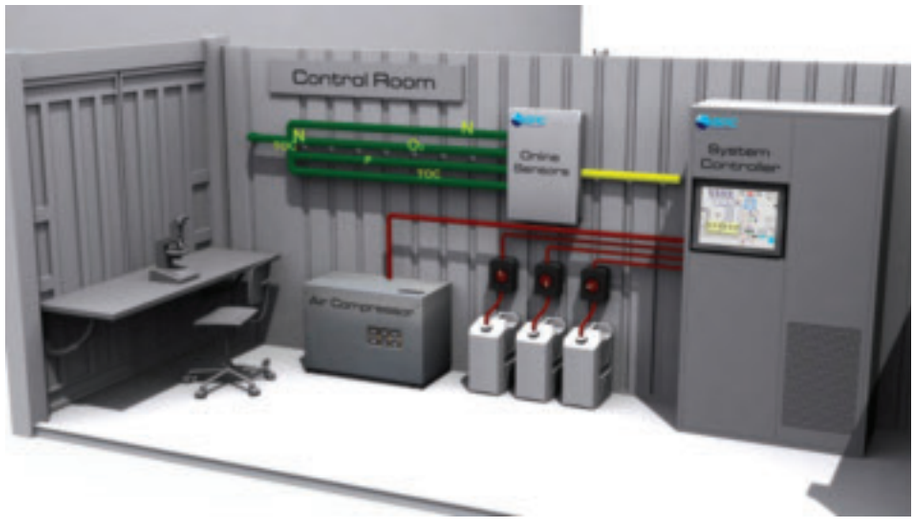
ACT utilises BPC's proprietary bioremediation technology to reduce hydrocarbons, TPH, COD and suspended solids from greasy or oily waters leaving effluent well below industry regulations. Once notified of the specific power plant issues, BPC tests isolated cultures of natural bacteria in various conditions to find the

most effective, custom solution for treating organic contaminants.

Once ACT is applied to the wastewater treatment processes, the Chemostat principle comes into play replacing traditional filtration methods, which typically lead to clogging and costly delays. ACT bioremediation treats both dissolved and non-dissolved organics while ultrafiltration addresses only non-dissolved particles larger than 1 µm.

BPC's installations offer full automation and online monitoring, eliminating the need for additional technical manpower. Each installation is integrated with online sensors, which detect and react in real-time to system errors. Any errors are dealt with automatically by troubleshooting and solving the problem on its own, or shutting down the system until it can be manually restored. At the same time, control systems receive a report of the error and subsequently notify operating personnel via SMS and email.

ACT bioremediation has been shown to drastically reduce the levels of the top contaminants in power station effluents and wastewaters. There have been proven reductions in hydrocarbon, TPH, COD, and total suspended solids levels far below what government standards dictate. Oil and grease waters are easily separated and treated, leaving behind the purest effluent, while pH is maintained between the appropriate levels (see Table 1).

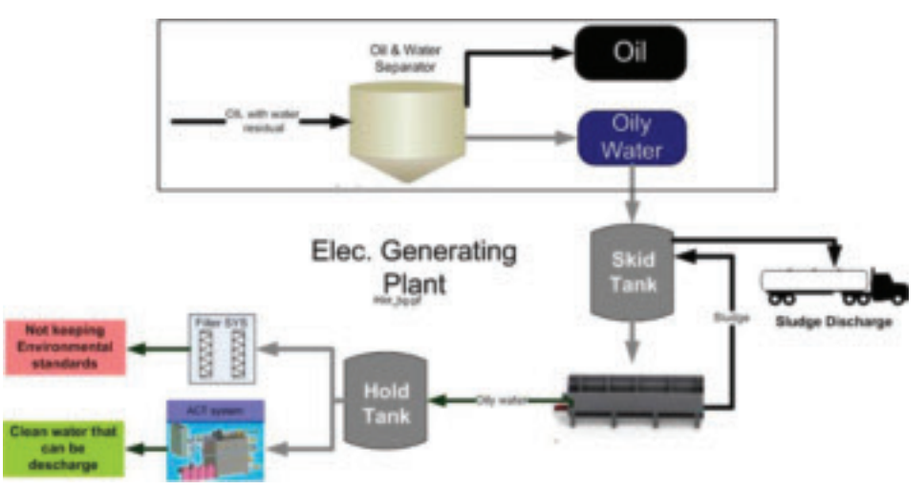


Automated Control System: the figure to the right illustrates the automated control and online monitoring system.

Many governments are now requiring diesel power plants to submit a safety and preparation plan describing the measures the plant will take to reduce toxic water emissions, and to prepare in the event of an unforeseen catastrophe or accidental oily water spill. These plans are especially a good idea for any diesel power plant that is isolated and therefore requires a fuel storage system, which can potentially leak into surrounding ground waters, soils, and streams.

During the current diesel power station process, diesel with water residue goes through an oil-water separator. Oily water is placed in the tank, and the cleanup process begins. Water goes through a chemical

Table 1: ACT System Results In Comparison to Current Purification Process				
Parameters (ppm)	**Units**	**Power Plant Effluent Quality After DAF Separation**	**ACT System Results**	**Discharge Requirements**
TPH	ppm	75.27	1-3	<10
TSS	ppm	492	15	50
pH		8.05	7-8.5	6<pH>9
Total P	ppm	5.7	0.5-1	<1
COD	ppm	1,680	50-150	250
TOC	ppm	377	30-70	150
TURBIDITY	NTU	573	10-15	25
Cr	ppm	<0.05	<0.05	0.5
Cu	ppm	0.1	0.1	0.5
Fe	ppm	1	1	1
Zn	ppm	0.7	0.7	2



Current system versus ACT diesel power station wastewater treatment process.

Figure 3: BPC integrates with existing infrastructure.

physical treatment, where floating oil particles are separated using chemicals. The sludge is then sent to a hazardous disposal site, while the water goes through a holding tank where it is discharged through a filtration system. Unfortunately, the water from the chemical treatment is still in poor quality and easily clogs the filter, rendering it useless. The water at this stage is actually ideal for a bioprocess, since all of the organic compounds are dissolved in the water.

After the oil–water separation, water goes into a skid tank where sludge is removed leaving oily water. The oily water then goes through a chemical-physical separation, sending higher quality water into a holding tank. Here, two solutions are available, the traditional filtration system and BPC's ACT bioremediation system, which produces a higher quality effluent that can be directly discharged into the environment.

ACT is available in various forms for different wastewater needs, such as refineries, drainage water, bilge water, storm water and any other petrochemical wastewater effluent. A one-time application is available, and has been proven to be quite efficient when dealing with spontaneous cleaning needs. Storm water, run-off water, and other spontaneous water accumulations are no longer a challenge for power stations. BPC also offers systems for small/medium scale and large scale capacities.

BPC also gives the option of a pilot system, which enables a test to be performed of how specific power station effluents will react to the BPC process. In addition, it allows for real-time adjustments to be made to tailor the solution for optimum effectiveness. The pilot test also enables power station operators to view first-hand the effectiveness of the process for their particular wastewater needs.

Case study – Eilat-Ashkelon Pipeline Company

In one specific case, BPC implemented its technology at the Eilat-Ashkelon Pipeline Company (EAPC). Using a fully-automated biological skid-mount system, BPC was able to treat drainage and ballast water on-site. BPC provided a cost effective solution, utilising existing infrastructure, giving EAPC the ability to improve and control the quality of its wastewater.

The company's former method of water treatment was based on the use of a gravitational oil separator, following which the inadequately treated water was released into permeation lagoons in close proximity to the shoreline. The treatment flow rate was 5m³/hour and contained a 4% salinity level. EAPC was having difficulties in adhering to the required environmental standards, and was strongly criticised for polluting the waters surrounding the terminal.

With all of the components for the full scale solution in place, BPC's bio-reactor was installed at the EAPC site. The system integrated well with existing infrastructure. As shown in Figure 3, the ACT bio-reactor integrated with EAPC's existing tanks and separators. EAPC's gravitational separation method fed directly into the BPC bio-reactor for efficient and rapid processing.

The integration was achieved by installing a skid mount control and monitoring system. EAPC was using an old API as the bio-reactor and the new system enabled the company to clean the water to a much higher quality level. ●

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