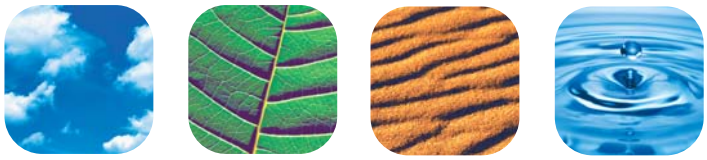

A COMMERCIAL APPLICATION OF VIROFLOW™ TECHNOLOGY

CASE STUDY: WASTEWATER TREATMENT AT AN INDUSTRIAL SITE IN THE UNITED KINGDOM

"The application of the ViroFlow™ Technology filter system resulted in the successful treatment of heavy metal contaminated wastewater that had been collected from around the site and posed a significant potential environmental and health risk."

(Left) The industrial site in London were metals are processed
(Above) Close-up view of the ViroFlow™ Technology filter

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This large industrial complex in Kent, is a refiner and smelter of metals. The complex is one of the world's largest primary refiners of lead and alloys, with a capacity to produce around a third of a million tonnes of lead and alloys per annum. Located on the River Thames, the refinery and smelter are positioned along a corridor of large industrial complexes that collectively have significant potential to impact the quality of water in the Thames. All waste discharges in this region are therefore tightly controlled by the UK Environment Agency.

As a result of frequent rain events in the area, run-off from the industrial complex has the potential to transport substantial quantities of heavy metals. This run-off is collected in several pits around the complex from where it is pumped into a holding lagoon. Once the liquid in the holding lagoon reaches a specific level it is pumped to a wastewater treatment facility prior to discharge into the Thames. This process allows contaminated run-off from the site to be collected and contained on site in an environmentally and industrially safe manner until it can be treated and discharged, thereby preventing uncontrolled discharges. In this way, site run-off is controlled, treated and discharged with a minimum of potential risk of exposure or discharge, and represents industry best practice.

ViroFlow™ Technology was demonstrated at the site to determine if the already low levels of metal contamination in the collected run-off could be reduced still further using a passive filtration system. This case study documents the results of the demonstration.

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Initial laboratory trials had proven the ability of ViroFlow™ Technology to treat soluble metals and higher than allowable pH values in the lagoon effluent. It had been shown that concentrations of cadmium, lead, and zinc, for example, could be reduced to below current consent levels by passage of the effluent through a filter column containing porous ElectroBind™ pellets, one of the principal reagents used by Virotec in applying its ViroFlow™ Technology total solution. However, significant, albeit low, concentrations of arsenic and antimony are sometimes present in the run-off (specifically when the plant's rotary furnace is in operation), and the concentrations of these elements should also be reduced to low levels in any effective treatment solution.

The site demonstration of ViroFlow™ Technology for the treatment of lagoon effluent through a simple filtration system containing ElectroBind™ reagent took place in 2007. The components of the trial included the filtration system, containing acid adjustment, iron adjustment, solids settling and treatment phases, as well as on-site support and technical advice. Monitoring, sampling and analysis were carried out by refinery staff.

TREATMENT METHODS

Run-off contained in the plastic-lined holding lagoon was pumped to the ViroFlow™ Technology filter system, where it was treated with a direct addition of iron sulphate and sulphuric acid prior to being pumped through a baffle weir to promote the settling of solids. From the baffle it was gravity-fed through the filtration column, which contained ElectroBind™ porous pellets, and flowed down through the column prior to sampling and discharge.

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Figure 1: Part of the complex from where contaminated site run-off is generated; the run-off from the plant may be contaminated with lead, cadmium copper and zinc, among other heavy metals.

Figure 2: Two of the collection pits where the metal-contaminated site run-off is collected by mechanical sweepers prior to pumping to the holding lagoon.

Figure 3: The lined holding lagoon where contaminated site run-off is collected and held prior to treatment by the ViroFlow™ Technology filtration system.

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Figure 4: Contaminated site run-off was pumped from the holding lagoon to this ViroFlow™ Technology filter system, which included an iron and acid dosing phase, a solids' settling phase, and a filtration and metal-binding phase.

The contaminants of primary concern were antimony (Sb), arsenic (As), cadmium (Cd), copper (Cu), lead (Pb), nickel (Ni), and zinc (Zn). Elevated pH values were also observed and these had to be reduced to between pH of 6.0 and 9.0.

Figure 5: Close-up view of the ViroFlow™ Technology filter with acid- and iron-adjusted wastewater dispersed over the head of 2-6mm porous ElectroBind™ pellets.

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RESULTS

Results from the application of ViroFlow™ Technology are shown in Table 1.

TABLE1: CONTAMINANT ELEMENT CONCENTRATIONS BEFORE AND AFTER VIROFLOW™ TECHNOLOGY TREATMENT AND THE REQUIRED TREATMENT TARGETS (DISCHARGE LIMITS)

Parameter	Before ViroFlow™ Technology (influent to the Filter System)	Before ViroFlow™ Technology (Effluent from the Filter System)	Treatment Targets
pH	*10.2*	*7.4*	*6.0-9.0*
As (mg/L)	*0.34*	*BDL*	*0.1*
Cd (mg/L)	*0.14*	*0.02*	*0.03*
Cu (mg/L)	*0.18*	*0.02*	*0.1*
Ni (mg/L)	*0.03*	*0.02*	*0.1*
Pb (mg/L)	*4.52*	*0.06*	*1.0*
Sb (mg/L)	*9.26*	*0.49*	*0.5*
Zn (mg/L)	*1.5*	*0.16*	*0.5*

BDL = Below the detection limit of analytical measurement.

From the results presented in Table 1, it can be seen that by using ViroFlow™ Technology all treatment targets were met and the contaminated industrial run-off could be safely discharged. While the significant changes in the higher and more worrying starting concentrations of Pb and Sb should be highlighted (98.5% and 95% respectively), large reductions were also observed in As (90%+), Cu (85%) and Zn (90%) concentrations. Similarly, changes in pH were also observed, with the higher and out-of-compliance pH values being brought to within acceptable limits.

CONCLUSION

The application of ViroFlow™ Technology at this large London industrial complex resulted in all the treatment targets required for discharge of the contaminated run-off water being met. ViroFlow™ was successful in adjusting pH and lowering the concentrations of heavy metals and metalloids (As and Sb) in the liquid phase to below target values; the concentration of arsenic in the treated water was below detection.

The "spent" ElectroBind™ pellets removed from the filtration system after use were inert and non-hazardous, and could be disposed of without difficulty in ordinary landfill. Previous research has shown that the longer the contaminant elements are sequestered in the pellet matrix of

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ElectroBind™, the more permanently they are bound, with the strength of binding increasing by as much as 40% every six months after the ElectroBind™ pellets have been saturated with soluble metals.

For these reasons, ViroFlow™ Technology has been identified as a fully sustainable waste treatment solution; it has not only repeatedly solved the problem of treating heavy metal-and metalloid-contaminated wastewater, in this case, industrial run-off, but does not result in the production of another kind of waste. Rather than merely transferring or converting one form of waste into another form of waste (e.g. solving the problem of waste liquid but creating a new problem of waste solids) ViroFlow™ Technology provides a practical and permanent solution for immediate and long-term industrial waste management.

As demonstrated in this project in the United Kingdom, ViroFlow™ Technology, using ElectroBind™ porous pellets in a simple filtration configuration, resulted in the permanent and sustainable removal of dangerous heavy metals and metalloids from the industrial cycle.

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