

A COMMERCIAL APPLICATION OF  
VIROFLOW™ TECHNOLOGY

## CASE STUDY VIROFILTER™ TREATMENT SYSTEM AT LARGE STEEL MILL

*“The ViroFilter™ treatment system proved that it could produce an “inert” waste product, effectively re-classifying the existing waste...”*



*The ViroFilter™ Treatment System*

## PROBLEM

Virotec Global Solutions was contracted to demonstrate its ViroFlow™ Technology in a heavy industrial setting at a large-scale steel mill in NSW, Australia.

The purpose of the four-week demonstration was to determine the viability of a ViroFilter™ Treatment System around two main criteria:

- > Effectiveness in producing a waste product which was not classed as “hazardous” and was preferably classified as an “inert” waste.
- > Effectiveness in treating industrial wastewater to Sydney Water discharge standards.

Additionally, the steel mill had significant reagent storage compliance issues with its current chemical treatment reagent storage system (lime and hydrochloric acid) in that it was not compliant with the Australian Dangerous Goods Code. The ViroFilter™ Treatment System would allow the steel mill to minimise the use of hazardous reagents, such as lime and hydrochloric acid, with a consequent improvement in plant risk profile and compliance.



*ElectroBind™ Reagent pellets.*

## SOLUTION

The pressurised ViroFilter™ Treatment System, using pelletised ElectroBind™ reagent, was used to achieve the following:

- > Replace a hazardous solid waste with an inert solid waste, with the further possibility of that waste being used for other down-stream purposes;
- > Eliminate lime usage;
- > Eliminate or reduce caustic soda usage;
- > Potentially eliminate the need for clarifier, thickener and filter press operations; and,
- > Reduce operating costs.

The ViroFlow™ Technology components included design, engineering, application, and monitoring of the ViroFilter™ Treatment System.

## BACKGROUND

Wastewater from the processing and treatment of powder coated and pre-painted steel at the steel mill had a pH of between 1.0 and 2.0, and had high concentrations of several heavy metals, particularly iron and chromium (e.g. Fe, 400-800 mg/L with pH 1.2) and industrial contaminants.

The wastewater was stored prior to treatment, depending upon the type of contamination, in three separate storage tanks each with a capacity of one third of a million litres, representing about 24 hours storage. The plant was designed to treat a maximum



*The existing wastewater treatment plant at the steel mill.*

flowrate of 1.3 million litres a day.

## TREATMENT METHOD

A ViroFilter™ Treatment System was installed at the steel mill's wastewater treatment plant and fed a side stream of the plant's effluent from the outlet of the chromium reduction stage. In order to treat water for a period of four to six weeks, a treated water flowrate of 500 L/hr was chosen, with the chosen flow rate being a function of residence time in the filter vessel.



*The commissioned system.*

The System consisted of a series of two reaction columns. Each column was packed as shown in Figure 1 with multi-layered gravel at the bottom to ensure adequate dispersion and to minimise the effect of channelling or preferential flow paths forming. The ViroFlow™ Technology reagent chosen for this treatment was ElectroBind™ pellets; these were charged into each column as shown in the images on this page.

The below image shows a layer of clean sand was packed above the ElectroBind™ pellets to ensure complete suspended solids removal from the treated effluent. The reaction columns are manually packed by Virotec engineers and the fully commission ViroFilter™ Treatment System. A detailed cross-section of the reaction column packing is shown in Figure 1.

The System was a complete, turn-key filtration system, including technology licensing, filter cartridge, mobilisation, installation and commissioning, and ongoing support.

ElectroBind™ pellets are a patented, environmentally safe reagent that is non-toxic and nonhazardous, and is classified as an “inert solid”.



*The reaction columns being manually packed by Virotec engineers and the fully commissioned ViroFilter™ Treatment System.*

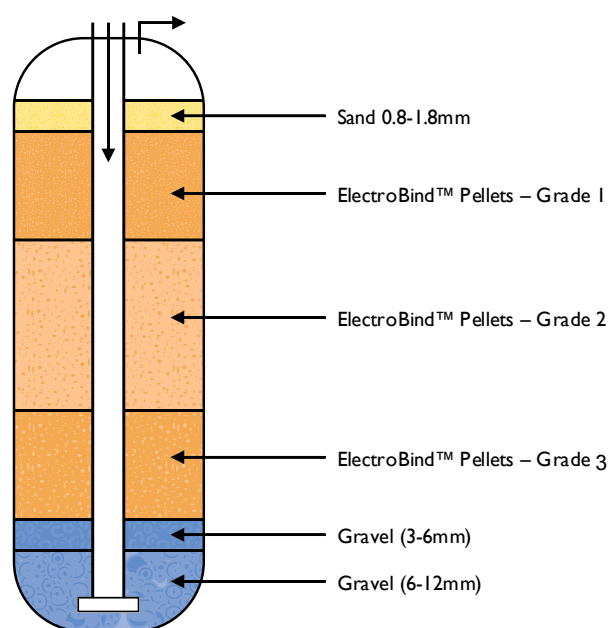


FIGURE 1 - VIROFILTER™ TREATMENT SYSTEM REACTION COLUMN CROSS SECTION

TABLE 1 - RESULTS FOR THE VIROFILTER™ TREATMENT SYSTEM - Cr & Fe  
(Concentrations are given in mg/L)

Sample	Chromium (mg/L)		Iron (mg/L)	
	Raw Effluent	ViroFilter™ Treated	Raw Effluent	ViroFilter™ Treated
4/5/04 am	50	0.5	324	22
4/5/04 pm	72.36	1.5	341	2
7/5/04 am	48	0.8	331	<0.1
14/5/04 am	73.6	0.7	437	2.9
14/5/04 pm	32.6	<0.5	438	0.5
18/5/04 am	74.6	<0.5	770	0.3
18/5/04 pm	44.9	<0.5	800	0.2
19/5/04 am	53	<0.5	2145	6.9

## RESULTS

Inlet and outlet water samples were taken throughout operation of the System according to a detailed sampling and analysis plan. A summary of the results for the four-week trial are shown in Tables 1, 2 and 3 overleaf. Table 4 details the trade waste concentration limits for the steel mill's wastewater treatment plant discharge.

The results show that the wastewater could be effectively treated by the ViroFilter™ Treatment System to achieve concentrations of heavy metals that are well below the discharge limits.

**Table 2 – RESULTS FOR THE VIROFILTER™ TREATMENT SYSTEM – Cu & Pb**  
(Concentrations are given in mg/L.)

Sample	Copper (mg/L)		Lead (mg/L)	
	Raw Effluent	ViroFilter™ Treated	Raw Effluent	ViroFilter™ Treated
4/05/04 am	<0.3	<0.3	<0.3	<0.3
4/5/04 pm	<0.3	<0.3	<0.3	<0.3
7/5/04 am	<0.3	<0.3	<0.3	<0.3
14/5/04 am	<0.3	<0.3	<0.3	<0.3
14/5/04 pm	<0.3	<0.3	<0.3	<0.3
18/5/04 am	<0.3	<0.3	7.3	<0.3
18/5/04 pm	<0.3	<0.3	6.7	<0.3
19/5/04 am	<0.8	<0.3	4.5	<0.3

**Table 3 – RESULTS FOR THE VIROFILTER™ TREATMENT SYSTEM – Zn**  
(Concentrations are given in mg/L.)

Sample	Zinc (mg/L)	
	Raw Effluent	ViroFilter™ Treated
4/05/04 am	22	0.3
4/5/04 pm	24	0.8
7/5/04 am	160	0.3
14/5/04 am	2.0	0.5
14/5/04 pm	2.5	0.1
18/5/04 am	18	0.1
18/5/04 pm	8.7	0.2
19/5/04 am	160	0.3

**Table 4 – TRADE WASTE DISCHARGE LIMITS**

Pollutant	Trade Waste Discharge Limit (mg/L)
Chromium	3
Copper	5
Iron	50
Lead	2
Zinc	5

The spent pellets from the ViroFilter™ Treatment System were analysed to determine the classification under Australian NSW EPA Guidelines (Table 5). Two samples were collected from the decommissioned system. The first sample was collected from the inlet section of the first filter column to ascertain a worst case scenario because the ElectroBind™ pellets in this section would have the highest contaminant loading. The second sample was a composite collected from the three sections of the ElectroBind™ pellets taken from both filter columns.

The results show that both pellet samples met the Guidelines for classification as an inert waste. The ViroFilter™ Treatment System proved that it could produce an “inert” waste product, effectively re-classifying the existing waste from hazardous to a non-hazardous material and offering substantial savings on disposal costs. Results of the analysis on the decommissioned pellets are shown in Table 5 and are compared against the Australian NSW EPA Guidelines for inert waste classification.

**Table 5: Results of Pellet Analysis**

Contaminant	High Exposure Pellet Sample	Composite Pellet Sample	Threshold Value for Inert Waste Classification
Fluoride (mg/kg)	43	31	300
Aluminium (mg/kg)	4,600	4,500	No limit
TCLP Aluminium (mg/L)	63.7	6.23	No limit
Chromium (mg/kg)	663	688	No limit
TCLP Chromiun (mg/L)	4.1	0.5	No limit
Copper (mg/kg)	32	23	No limit
TCLP Copper (mg/L)	<0.05	<0.05	No limit
Iron (mg/kg)	12,600	11,800	No limit
TCLP Iron (mg/L)	2.96	1.07	No limit
Lead (mg/kg)	68	65	1500
TCLP Lead (mg/L)	<0.05	<0.05	0.5
Tin (mg/kg)	9.4	8.3	No limit
Zinc (mg/kg)	468	383	No limit
TCLP Zinc (mg/L)	0.42	0.22	No limit
Benzene (mg/kg)	<0.2	<0.2	1.0
Toluene (mg/kg)	<0.5	<0.5	28.8
Ethylbenzene (mg/kg)	<0.5	<0.5	60
Xylenes (mg/kg)	<1	<1	100
C6 - C9 Hydrocarbons (mg/kg)	<10	<10	650
C10 - C36 Hydrocarbons (mg/kg)	<260	<260	5,000

## CONCLUSION

ViroFlow™ Technology demonstrated that it was effective in producing a waste product at a steel mill wastewater treatment plant which is classified as an “inert waste”. Furthermore, a unique property of the ViroFilter™ Treatment System employed in this application was that the pelletised filter cartridge, once used for metal contaminant removal, can be classified as an inert solid; hence disposal of the spent pellets to landfill (at minimal cost) or, preferably, re-use in other remediation works, are realistic options.

ViroFlow™ Technology proved itself as a simple, low-cost method to treat steel mill industrial wastewater to stringent regulatory licence limits.