UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
999 18TH STREET - SUITE 300
DENVER, CO 80202-2466
Phone 800-227-8917
Http://www.epa.gov/region08

May 27, 2004
Ref: EPR-SR

Brian Sheeran CEO
Virotec International, Ltd
50B Pinewood Drive
Sanctuary Cove, QLD 4212
Australia

Dear Mr. Sheeran:

As you know, during 2001-2004 several of your associates have been involved with the treatability study process at the Gilt Edge Mine NPL Site in Lawrence County, South Dakota.

As was done last year for the other contributing organizations to the treatability studies, I (with assistance from EPA's technical support contractor CDM Federal Programs Corporation) wanted to provide you with some information about the progress and results of Virotec International Ltd's work at the Site. We appreciate Virotec's collaborative efforts with the U.S. Environmental Protection Agency of Region VIII in these efforts.

In 2000, during the process of placing the recently-abandoned Gilt Edge Mine site on the National Priorities List for hazardous and toxic waste cleanup, the U.S. Environmental Protection Agency – Region VIII (EPA8) was asked by various companies to consider their technologies and cleanup processes.

EPA8 had been aware of some of the emerging technologies and invited several companies to participate in a Multi-Cell Treatability Study at the Site in South Dakota.

The study was designed to provide a side-by-side comparison of emerging waste rock stabilization technologies that were designed to prevent or suppress the production of acidic metal-laden leachates.

The test program was originally planned to evaluate four waste rock stabilization technologies that were available for the treatment of Acid Rock Drainage (ARD). As the Multi-Cell Treatability

Study was commencing in late 2000, EPA8 learned of a ViroMine™ reagent (at the time referred to as Bauxsol) developed by Virotec International Ltd from Bauxsol™ Technology, and contacted Virotec to learn more about this product.

EPA8 was quite interested in the purported characteristics and potential applicability of Bauxsol, and Virotec expressed strong interest and willingness to participate in some manner in the EPA8 Treatability Study program.

Subsequently, Virotec made arrangements to ship a quantity of Bauxsol to the Site from Australia, and a ViroMine™ test-cell was field-fitted and added after the original test program was established. An in-ground lined trench with generally similar characteristics to the cells used in the Multi-Cell Treatability Study was constructed and filled with ViroMine™-treated sulfidic waste rock (the "Bauxsol" Trench Trial). Except for replicate cells, the Trench Trial was designed to simulate as closely as possible the side-by-side comparison of all technologies.

In both studies, waste rock samples were analyzed for acid-base accounting, net acid generating potential, and a large target analyte list (TAL) of elements. All leachate water samples were analyzed for TAL elements and other standard water quality parameters.

Additionally, Virotec proposed, and in collaboration with EPA's technical support contractor CDM Federal Programs Corporation (CDMFP), three additional small field-trials were also set up to apply the ViroMine™ reagent to other potential applications for the product at the Gilt Edge Mine site.

All the trials followed EPA protocols, and none of the organizations providing the technologies being tested were allowed access to the Site except when accompanied by EPA representatives.

The objective of the study(ies) was to provide a completely independent assessment of the ability of the various treatments to:

- Reduce the quantity of contaminated leachates generated by highly acidic sulfidic from the Gilt Edge Mine waste rock, and
- Minimize the impact of these source materials on the downstream aquatic ecosystem and other potentially impacted areas.

EPA's intended use of the data acquired during the various treatability studies is to consider and evaluate options for cost-effective site remediation approaches at the Gilt Edge Mine consistent with the evaluation criteria laid out in the Part 300.430 regulations of EPA's National Contingency Plan.

EPA's findings to date indicate that ViroMine™ reagents may have several potential applications at the Gilt Edge Mine and possibly at other mine sites similarly affected by problems associated with acid rock drainage.

In particular, the Trench Trial data (Table 1) showed that a single 10% mixture of ViroMine™ reagent with the test waste-rock (some of the worst encountered at the Site) has produced high-quality leachate water, and the water quality has remained generally consistent over the three years since the treatment was applied.

At the other smaller field-trials, substantial improvements in water quality from the use of the ViroMine™ reagent in the single-year Pit Lake Simulation (2001), a flow-through Passive Treatment Test, and several Bauxsol-wasterock mixtures in Barrel Trials (Tables 2 - 4) were also evident.

Periodic sampling and analyses appears to indicate that the ViroMine™ reagent remains active in the Trench Trial waste-rock mixture more than three years after the original treatment was carried out, and leachates have continued to meet or exceed established water quality criteria for the Site.

Additionally, in 2003 an electron beam microprobe examination of a treated waste rock sample showed evidence of sulfide encapsulation. Results on a sample taken in Spring 2004 are pending.

Early in 2004, EPA Region VIII reviewed the results obtained so far and in consultation with Virotec agreed that in view of the very promising performance of the original ViroMine™ reagent in the original trials, along with EPA's need for quantitative data regarding metal-loading/sorption capacity, additional trials would be conducted with newer formulations of ViroMine™ reagent at the Gilt Edge Mine site.

Results of these trials are intended to enable EPA8 to better determine how ViroMine™ might be effectively used at the Gilt Edge Mine site and allow further evaluation and consideration of the applicability of ViroMine™ in the final feasibility study for the Site.

I hope you find this synopsis of Virotec's work and contributions to EPA's efforts at the Gilt Edge Mine Site to be helpful. Feel free to contact me at any time.

Sincerely,

MR. KEN WANGERUD
Remediation Project Manager
Superfund Remedial Program
USEPA – Region

Attachments: Data-tables

Cc: Steve Fundingsland, CDMFP

Table 1: ViroMine™ Waste Rock Trench Data

Analyte - Units	Control 2003	Result 2001	Result 2002	Result 2003
pH	1.93	7.9	7.96	
Acidity (mg/L as $CaCO_3$)	49,000	4	<LLD (5)	<LLD (5)
Alkalinity (mg/L as $CaCO_3$)	<LLD (5)	90	62	66
TDS (mg/L)	77,000	11,500	8,300	3,000
Sodium (mg/L)	9,300	2,970	2,990	570
Sulfate (mg/L)	55,000	6,000	5,800	2,200
Ag (µg/L)	150	<LLD (1)	1.1	<LLD (5)
Al (µg/L)	1,200,000	<LLD (50)	10	66
As (µg/L)	35,000	3.1	3.7	<LLD (10)
Cd (µg/L)	630	<LLD (1)	0.4	<LLD (1)
Co (µg/L)	2,200	1.5	11	<LLD (10)
Cr (µg/L)	390	<LLD (1)	12	<LLD (10)
Cu (µg/L)	33,000	8.2	7.2	<LLD (10)
Fe (µg/L)	21,000,000	< LLD (25)	18	120
Mn (µg/L)	34,000	17	0.3	<LLD (10)
Ni (µg/L)	1,600	2.1	1.4	<LLD (10)
Pb (µg/L)	390	<LLD (2.5)	2.9	<LLD (10)
Sb (µg/L)	500	<LLD (4)	48	<LLD (10)
V (µg/L)	1,700	<LLD (1)	1	<LLD (10)
Zn (µg/L)	29,000	42	21	<LLD (10)

Data for water leaching from sulfidic waste rock that had been treated using ViroMine™ reagent in the Trench Trial at the Gilt Edge Mine site; the data span the three years since the treatment was carried out.

The control data were obtained for leachate emanating from the same type of waste rock that had not been treated with ViroMine™ reagent. <LLD indicates that the concentration is below the detection limit for the analytical procedure used the detection limit is indicated in parentheses.

Table 2: ViroMine™ Waste Rock Drum Data

Analytes	Control 2003	Waste Rock 2001	Waste Rock 2003
pH	1.92	7.81	7.21
Acidity (mg/L as $CaCO_3$)	50,000	4	<LLD (5)
Alkalinity (mg/L as $CaCO_3$)	<LLD (5)	58	42
TDS (mg/L)	78,000	13,400	22,000
Sulfate (mg/L)	59,000	7,800	20,000
Ag (µg/L)	100	<LLD (1)	<LLD (5)
Al (µg/L)	1,400,000	<LLD (50)	<LLD (50)
As (µg/L)	23,000	9.2	<LLD (10)
Cd (µg/L)	1,100	<LLD (1)	<LLD (1)
Co (µg/L)	1,500	3.8	<LLD (10)
Cr (µg/L)	260	<LLD (1)	<LLD (10)
Cu (µg/L)	28,000	12.4	16
Fe (µg/L)	19,000,000	<LLD (25)	33
Mn (µg/L)	23,000	185	230
Ni (µg/L)	1,100	3.5	<LLD (10)
Pb (µg/L)	240	<LLD (2.2)	<LLD (10)
Sb (µg/L)	380	<LLD (3.7)	<LLD (10)
V (µg/L)	1,700	6.8	<LLD (10)
Zn (µg/L)	8,300	<LLD (25)	140

Examples of data for leachate accumulating in barrels containing sulfidic waste rock and various amounts of ViroMine™ reagent; these tests were used to determine the required ViroMine reagent addition rates. The results showed that a ViroMine™ reagent addition rate of 6 to 7% would be optimal.

The control data were obtained for barrels that contained waste rock but no ViroMine™ reagent. <LLD indicates that the concentration is below the detection limit for the analytical procedure used the detection limit is indicated in parentheses.

Table 3: ViroMine™ Pit Lake Data

Analytes	Initial Pit Lake Data	Treatment Results
pH	2.59	7.09
Acidity (mg/L as $CaCO_3$)	1,890	<LLD (5)
Alkalinity (mg/L as $CaCO_3$)	LLD (5)	28
TDS (mg/L)	4,800	4,300
Sulfate (mg/L)	3,100	2,800
Al (µg/L)	101,000	<LLD (37.4)
Cd (µg/L)	214	15.3
Co (µg/L)	520	127
Cr (µg/L)	61.7	<LLD (0.55)
Cu (µg/L)	27,300	16
Fe (µg/L)	235,000	29.6
Mn (µg/L)	6,070	2,560
Ni (µg/L)	293	81.8
Pb (µg/L)	4.4	<LLD (1.3)
Zn (µg/L)	4,110	21.9

The treatment of pit lake water was simulated by direct addition of ViroMine™ reagent to a 5,000 gallon tank filled with Dakota Maid Pit Lake water; the reagent was mixed with pit lake water to form a slurry and then slowly added to the tank to complete the treatment.

Analysis of a water sample taken 42 days after the final ViroMine™ addition showed an excellent improvement in water quality. <LLD indicates that the concentration is below the detection limit for the analytical procedure used the detection limit is indicated in parentheses.

Table 4: ViroMine™ Passive Treatment Data

Analytes	Initial Data	Treatment Results
pH	4.47	8.38
Acidity (mg/L as $CaCO_3$)	221	LLD (5)
Alkalinity (mg/L as $CaCO_3$)	LLD (5)	47
TDS (mg/L)	1,450	1,500
Sulfate (mg/L)	1,233	1,303
Al (µg/L)	22,418	<LLD (62)
Cd (µg/L)	121	<LLD (0.4)
Co (µg/L)	258.5	<LLD (1)
Cr (µg/L)	1.2	<LLD (0.5)
Cu (µg/L)	1,895	20.6
Fe (µg/L)	582	<LLD (21.1)
Mn (µg/L)	10,263	3
Ni (µg/L)	225	<LLD (2)
Pb (µg/L)	4.6	<LLD (2.6)
Zn (µg/L)	3,790	36.2

The possible use of ViroMine™ in a passive treatment system was tested by passing acidic metal-contaminated water from Hoodoo Gulch through a drum containing 52.3 kg of ViroMine™ reagent mixed with sufficient sand and gravel to maintain adequate hydraulic conductivity.

The passive treatment system produced excellent quality water and the data indicated that under the right circumstances they could produce even better quality water than the treatment of acid rock drainage water by direct addition of ViroMine™ reagents. <LLD indicates that the concentration is below the detection limit for the analytical procedure used the detection limit is indicated in parentheses.