Comprehensive Environmental Solutions, Inc.

PROCESS POTENTIAL STUDY

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Effect of Solid New Mex Humate Treatment on Heavy Metal Removal

AIM:

Our purpose is to measure the ability of solid New Mex Humate provided by U-Mate International Inc. of Scottsdale, Arizona to remove heavy metals from treated industrial process waste streams. We are attempting to find a finishing treatment that can reduce the concentration of some of the more problematic elements, such as cobalt, nickel, tin and zinc.

SCOPE:

A waste stream composite sample is spiked with all thirteen regulated elements. This material is then analyzed and used as a baseline to examine increasing levels of solid humate additions. These results, in turn, will be compared to other treatment options at a later date.

SAMPLE PREPARATION:

Several portions of wastewater, taken in April 2004, were combined into one sample and dubbed "April Composite". The sample was then spiked with all thirteen regulated elements, to a level of approximately 0.2 ppm, and then adjusted to a pH of 7 with caustic and sulfuric acid. The pH adjustment resulted in the formation of a precipitate. This material was mixed, suspended and rapidly separated into five subsamples. The first of these is this raw pH adjusted suspension. The next sample was centrifuged to remove all solid particles. This material used as a baseline to compare against all subsequent treatments. The last three samples were prepared by adding increasing levels of solid humate to 50 ml of the raw April Composite. These mixtures were stirred briefly, by hand, and then allowed to sit for one hour before centrifuging. The clear liquids were analyzed for their heavy metal content.

Identification	**Treatment**	**Description**	
Sample #1:	None	50 ml raw sample	Uncentrifuged
Sample #2:	None	50 ml sample	Centrifuged
Sample #3:	Solid Humate 10%	5 gram Solid Humate + 50 ml raw sample	Centrifuged
Sample #4:	Solid Humate 20%	10 gram Solid Humate + 50 ml raw sample	Centrifuged
Sample #5:	Solid Humate 50%	25 gram Solid Humate + 50 ml raw sample	Centrifuged

These samples were prepared for analysis by taking a 50 ml aliquot of each and adding 2 ml of 1:1 nitric acid and 1 ml of 1:1 hydrochloric acid. These samples were heated to a gentle boil, digested, cooled and then diluted back to their original volume.

ANALYTICAL RESULTS:

All samples were analyzed for the thirteen key elements and iron on a Leeman Labs, Model Profile Plus ICP Spectrometer. All results are given in units of part per million (ppm).

Element / Symbol		**April Composite pH 7 Raw Uncentrifuged**	**April Composite pH 7 Centrifuged**
Antimony	**Sb**	0.254	0.165
Arsenic	**As**	0.281	0.086
Cadmium	**Cd**	0.229	0.098
Chromium	**Cr**	0.309	0.120
Cobalt	**Co**	0.487	0.479
Copper	**Cu**	0.278	0.138
Lead	**Pb**	0.261	0.159
Nickel	**Ni**	4.25	4.49
Silver	**Ag**	0.323	0.148
Tin	**Sn**	0.530	0.172
Titanium	**Ti**	0.257	0.106
Vanadium	**V**	0.271	0.158
Zinc	**Zn**	1.94	0.813
Iron	**Fe**	37.9	24.6

ND = Not Detected

Element / Symbol		April Composite pH 7 Solid Humate 10%	April Composite pH 7 Solid Humate 20%	April Composite pH 7 Solid Humate 50%
Antimony	**Sb**	0.079	0.064	0.072
Arsenic	**As**	0.021	0.126	0.010
Cadmium	**Cd**	0.021	0.009	0.016
Chromium	**Cr**	0.066	0.047	0.057
Cobalt	**Co**	0.388	0.299	0.330
Copper	**Cu**	0.051	0.043	0.046
Lead	**Pb**	0.070	0.028	0.058
Nickel	**Ni**	3.93	3.85	3.66
Silver	**Ag**	ND	ND	ND
Tin	**Sn**	0.036	ND	0.024
Titanium	**Ti**	0.031	0.025	0.028
Vanadium	**V**	0.049	0.025	0.038
Zinc	**Zn**	0.570	0.500	0.507
Iron	**Fe**	4.62	ND	1.26

ND = Not Detected

PERCENT HEAVY METAL REDUCTION AT 10 % SOLID HUMATE ADDITION

Silver	100%	**Vanadium**	69%	**Arsenic**	44%
Iron	81%	**Copper**	63%	**Zinc**	30%
Tin	79%	**Lead**	56%	**Cobalt**	19%
Cadmium	79%	**Antimony**	52%	**Nickel**	12%
Titanium	71%	**Chromium**	45%		

OBSERVATION:

An unexplained spike occurred, in the concentration of arsenic, on the 20% Solid Humate sample. The solution was retested and the high arsenic level has been confirmed. The root cause of this spike is not known, but a contamination of the beaker, the funnel or the sample vial is suspected.

CONCLUSIONS:

- The solid humate treatment resulted in measurable reductions, in all fourteen elements tested elements.
- The greatest reduction in heavy metal concentration occurred following the 20% solid humate addition.
- The solid humate treatment appeared to remove heavy metals more effectively than the humate leachate, from the previous report.
- Higher additions of solid humate do not substantially improve the performance. Solid humates alone are most effective at a 20 % addition.
- Significant reductions occurred, in the levels of silver, iron, tin, cadmium, titanium, vanadium, copper, lead, antimony, chromium and arsenic.
- Marginal reductions occurred in the levels of zinc.
- Liquid humates alone are not an effective treatment for cobalt and nickel.
- Of the four most problematic elements, tin is effectively reduced, by this treatment, as is zinc, to a lesser degree.

RECOMMENDATIONS:

- Investigate the effect of solid humate additions, from a range of zero to 10 %.
- Compare solid humates to other treatments.