

. U-MATE INTERNATIONAL, INC.

PROCESS POTENTIAL STUDY

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Effect of New Mex Humate Leachate Treatment on Heavy Metal Removal

AIM:

Our purpose is to measure the ability of New Mex Humate leachate 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 varying levels of humate leachate 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 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 six subsamples. The first sample 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 four samples were composed of the April Composite with increasing additions of humate leachate.

<u>Identification</u>	<u>Treatment</u>	<u>Description</u>	
<u>Sample #1:</u>	None	50 ml raw sample	Uncentrifuged
<u>Sample #2:</u>	None	50 ml sample	Centrifuged
<u>Sample #3:</u>	Humate Leachate 0.5%	0.25 ml Humate Leachate + 50 ml raw sample	Centrifuged
<u>Sample #4:</u>	Humate Leachate 1%	0.5 ml Humate Leachate + 50 ml raw sample	Centrifuged
<u>Sample #5:</u>	Humate Leachate 5%	2.5 ml Humate Leachate + 50 ml raw sample	Centrifuged
<u>Sample #6:</u>	Humate Leachate 10%	5.0 ml Humate Leachate + 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).

<u>Element / Symbol</u>		<u>April Composite pH 7 Raw Uncentrifuged</u>	<u>April Composite pH 7 Centrifuged</u>	<u>April Composite pH 7 Humate Leachate 0.5%</u>
Antimony	Sb	0.254	0.165	0.124
Arsenic	As	0.281	0.086	0.049
Cadmium	Cd	0.229	0.098	0.054
Chromium	Cr	0.309	0.120	0.077
Cobalt	Co	0.487	0.479	0.455
Copper	Cu	0.278	0.138	0.089
Lead	Pb	0.261	0.159	0.117
Nickel	Ni	4.25	4.49	4.31
Silver	Ag	0.323	0.148	0.039
Tin	Sn	0.530	0.172	0.098
Titanium	Ti	0.257	0.106	0.053
Vanadium	V	0.271	0.158	0.089
Zinc	Zn	1.94	0.813	0.693
Iron	Fe	37.9	24.6	13.3

ND = Not Detected

Element / Symbol		April Composite pH 7 Humate Leachate 1%	April Composite pH 7 Humate Leachate 5%	April Composite pH 7 Humate Leachate 10%
Antimony	Sb	0.119	0.097	0.090
Arsenic	As	0.043	0.039	0.037
Cadmium	Cd	0.054	0.048	0.047
Chromium	Cr	0.081	0.072	0.070
Cobalt	Co	0.455	0.423	0.403
Copper	Cu	0.095	0.085	0.082
Lead	Pb	0.124	0.106	0.112
Nickel	Ni	4.25	3.96	3.86
Silver	Ag	0.039	0.032	0.041
Tin	Sn	0.099	0.082	0.080
Titanium	Ti	0.057	0.050	0.049
Vanadium	V	0.089	0.080	0.080
Zinc	Zn	0.688	0.623	0.612
Iron	Fe	14.4	12.8	11.1

ND = Not Detected

PERCENT HEAVY METAL REDUCTION AT 0.5 % HUMATE LEACHATE ADDITION

Silver	74%	Arsenic	43%	Antimony	25%
Titanium	50%	Tin	43%	Zinc	15%
Iron	46%	Chromium	36%	Cobalt	5%
Cadmium	45%	Copper	35%	Nickel	4%
Vanadium	44%	Lead	26%		

CONCLUSIONS:

- The humate leachate treatment resulted in measurable reductions in all fourteen elements tested elements.
- The greatest reduction in heavy metal concentration occurred following the 0.5% humate leachate addition.
- Higher additions of humate leachate do not substantially improve the situation. The humate leachate alone is effective only up to a 0.5 % addition.
- Significant reductions occurred, in the levels of silver, titanium, iron, cadmium, vanadium, arsenic and tin.
- Marginal reductions occurred in the levels of chromium, copper lead and tin.
- Humate leachate alone is not an effective treatment for zinc, cobalt and nickel.
- Of the four most problematic elements, only tin is substantially improved by this treatment.

RECOMMENDATIONS:

- Investigate the effect of humate leachate additions, between the range of zero to 0.5 %.
- Compare humate leachate to other treatments.
- Evaluate the combination of humate leachate with other treatment chemicals.