FINAL REPORT OF THE TREATMENT OF INDUSTRIAL TANNERY SLUDGE WITH PROBIOTICS TECHNOLOGY BY A COMPOSTING PROCESS METHOD

Colombia. November 2005

MAIN AIM

Remediation of the tannery sludge generated in the WWTP using the process of composting inoculated with PROBIOTICS.

SPECIFIC AIMS

- To use the PROBIOTICS technology to assess composting as an alternative for the treatment of sludge.
- Quantify levels of removal of heavy metals through a laboratory analysis.
- Verify the effectiveness of the PROBIOTICS technology in the odor control of the sludge.
- Demonstrate that the final product without any danger can be used for final disposal.

MATERIALS

The materials that were used for the development of this test were the following:

Solid waste from the tannery WWTP (sludge)	Sawdust
Coir pith	SCD PROBIOTICS™
Probiotics Ceramic Powder	Pump sprayer
Botcat	Thermometer & Plastic

METHODOLOGY

The pilot test began on August 4, 2005. The following methodology was used for the development of this test:

- Treatment A:

Sludge	(1173 Kg)	69%
Sawdust	(527 Kg)	31%
SCD PROBIOTICS™	(7 L)	
Probiotics Ceramic Powder	(170 grams)	

Sawdust was put on the floor, and then mixed with the sludge. The SCD PROBIOTICS™ and Probiotics Ceramic Powder were diluted with 30 Liters of water and placed into the pump sprayer, then the pile was sprayed in proportion to get close to 65% initial moisture..

This pile was turned three times per week for 4 weeks. Every day we assessed the internal temperature of the piley through the use of a thermometer and organoleptic external conditions. After, the pile, was covered with plastic to prevent absorption of rain.

- Treatment B:

Sludge	(1150 Kg)	88 %
Coir pith	(150 Kg)	12 %
SCD PROBIOTICS™	(5.5 L)	
Probiotics Ceramic Powder	(130 grams)	

Coir pith was put on the floor, and then mixed with the sludge. The SCD PROBIOTICS™ and Probiotics Ceramic Powder were diluted with 30 Liters of water and placed into the pump sprayer, then the pile was sprayed in proportion to get close to 65% initial moisture.

This pile was turned three times per week for 4 weeks. Every day we assessed the internal temperature of the piley through the use of a thermometer and organoleptic external conditions. After, the pile, was covered with plastic to prevent absorption of rain..

RESULTS AND DISCUSSION

Before discussing the results obtained in the laboratory, it is important to discuss the general, physical and organoleptic conditions of each treatment:

-Treatment A (Sludge + Sawdust):

Start the process with 1700 Kg, finishing with 750 kg, decreased during the process of 56%. Mix with sawdust achieves a more homogeneous incorporation of sludge from day 1. This treatment allows a quickly turning and in less than 2 days achieved the elimination of the characteristic smell of the sludge (putrefaction and chemical solvents). At the end of the process a very homogeneous material can be seen in color and a smell to forest top soil.

- Treatment B (Sludge + Coirpit):

Start the process with 1300 Kg, finishing with 610 Kg, decreased during the process of 53%. Mix with coconut fiber manages to absorb with least amount of dry material almost the same amount of the sludge that Treatment A. However are many lump or lumps that are not appreciated in the other treatment. It manages to efficiently reduce odors characteristic of the sludge, in a time of 3 days. At the end of the process you can appreciate even granules or lumps but a smell similar to the treatment A and homogeneous dark in colour.

Values RAS 2.000:

This is the Colombian technical regulations for the sector of drinking water and basic sanitation that indicates the maximum permitted values of a hazardous waste in a leachate

generated inside a landfill. The average of the samples without treatment evidence that all values are above the maximum permissible level. After the process of composting with application of PROBIOTICS technology, samples of both treatments presented substantial reductions in the content of heavy metals, fulfilling with the norm.

There are differences in the final results between two laboratories. While in the Austrian the laboratory results values can be seen in the parameter chromium (Cr), the results of the Colombian laboratory do not detect the presence of this element.

All items reduced its contents between the initial phase and the final composting process with application of PROBIOTICS technology.

The treatment with more succees in reduction of heavy metals was with sawdust as dry matter. This result coincides in both laboratories results.

The presentation of these results to the environmental authorities will allow the approval of this method for the final disposal of this material in a landfill or as a soil conditioner for reaforestation.

Table 1. Heavy Metals Content in the Samples

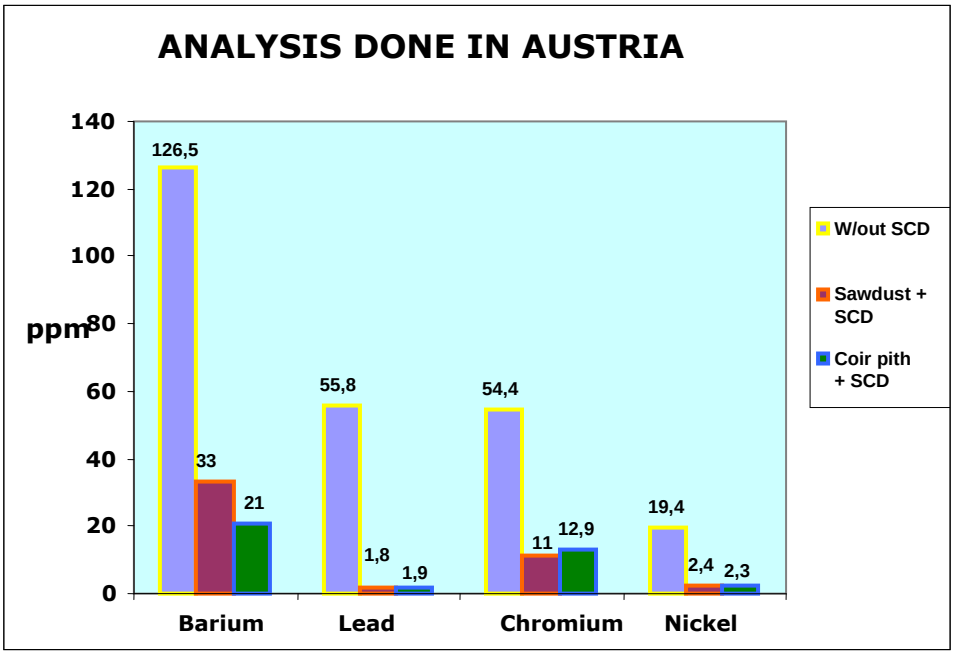
Analysis done in Austria

	Initial Value Sample 1	Initial Value Sample 2	Average	Sample of Sawdust	% Red.	Sample of Coir pith	% Red.	Values RAS 2000 Leachate ppm	Values NTC 1927 ppm
Chromium(Cr)	60,8	48	54,4	11	80%	12,9	76%	**5,0**	**1200**
Nickel (Ni)	25,4	13,4	19,4	2,4	88%	2,3	88%		**420**
Copper(Cu)	4020	3627	3823,5	561	85%	481	87%		
Zinc(Zn)	189	164	176,5	54	69%	60	66%		
Arsenic(As)	2	1,8	1,9	0,5	74%	0,6	68%	**5,0**	**41**
Cadmium(Cd)	3,5	3,4	3,45	0,3	91%	0,2	94%	**1,0**	**39**
Antimony (Sb)	0,14	0,12	0,13	0,04	69%	0,03	77%		
Barium (Ba)	127	126	126,5	33	74%	21	83%	**100**	
Mercury(Hg)	0,3	0,3	0,3	0,09	70%	0	100%	**0,2**	**17**
Lead(Pb)	50,7	60,8	55,75	1,8	97%	1,9	97%	**5,0**	**300**

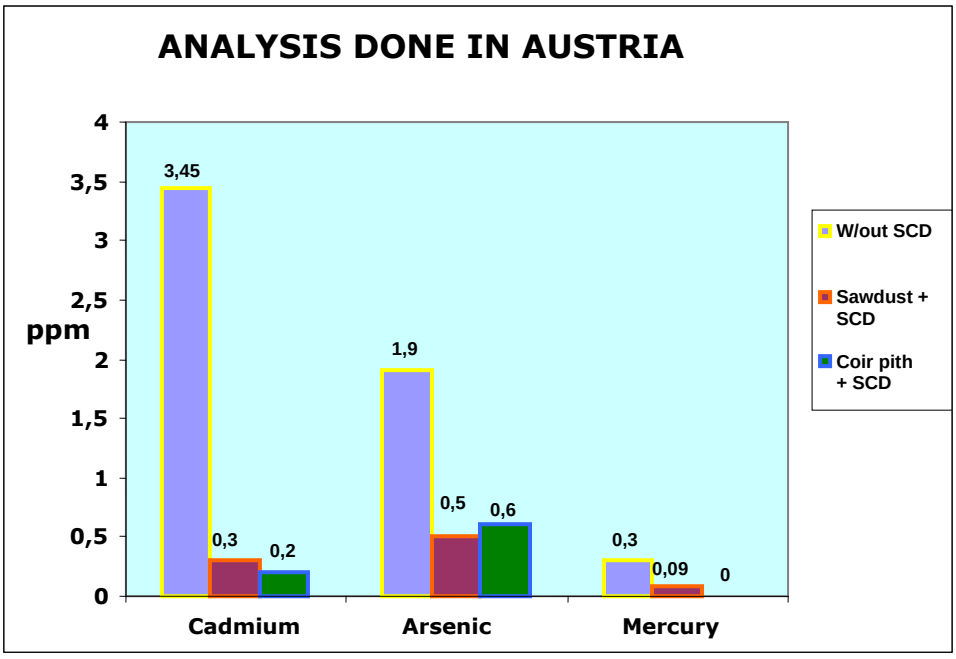
Values NTC 1927:

This is the Colombian technical norm that regulates the maximum levels permitted by ICA (Colombian Agricultural Institute) for heavy metals that may contain a soils conditioner or bio compost. In both treatments referred to as heavy elements are within permitted levels, which gives us the certainty of being able to use this material as a conditioner of soils for forestry use preferably, as the origin of the material to be treated does not permit direct use in agriculture for food for human consumption.

Graphic # 1. Elements Remotion Levels (Austria)



Graphic # 2. Elements Remotion Levels (Austria)



As discussion altogether manages to demonstrate that there is a decrease with either of the two treatments of the contents of the existing heavy metals in the material to be treated. This reduction is corroborated with the analysis of two different laboratories

To analyze a sample as a soil conditioner, the ICA recommends that the macro and micronutrients have to be reported.

N, P, K: It is important to remember that this is an inert material. However, in the case of mixing with coir pith mainly, phosphorus and potassium contents are higher than with

Analysis done in COLOMBIA (Universidad of Antioquia)

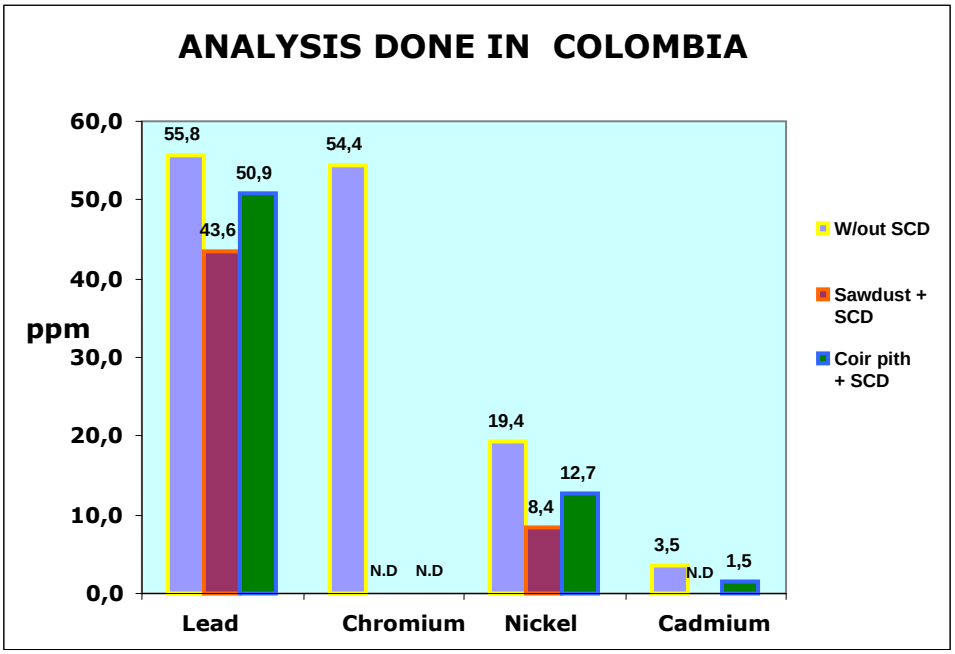
	Initial Value Sample 1	Initial Value Sample 2	Average	Sample of Sawdust	% Red.	Sample of Coir pith	% Red.	Values RAS 2000 Leachate ppm	Values NTC 1927 ppm
Chromium(Cr)	60,8	48	54,4	N.D.	-	N.D.	-	**5,0**	**1200**
Cadmium(Cd)	3,5	3,4	3,45	N.D.	-	1,53	56%	**1**	**39**
Lead(Pb)	50,7	60,8	55,75	43,58	22%	50,89	9%	**5,0**	**300**
Nickel(Ni)	25,4	13,4	19,4	8,43	57%	12,7	35%		**420**

N.D.: No detected

sawdust, because is used the material that surrounds the fruit. For the generation of any fruit that allows its development is potassium the main element needed, this is the explanation of why the treatment B there is more potassium that in A.

The micro nutrients present in the composted material are at the level of any soil conditioner.

Graphic # 3 Elements Remotion Levels (Analysis Colombia – U. of Antioquia)



The parameters pH, conductivity, bulk density, organic carbon, moisture and water holding capacity, comply with the levels required by the ICA.

Table 2. Phisical-Chemical Analysis of the Samples

	Sludge + Sawdust	Sludge + Coirpit	
Parameter	**Result**	**Result**	**Unit**
Nitrogen	0.65 ± 0.06	0.52 ± 0.04	%
Phosphorous	0.523 ± 0.014	0.810 ± 0.073	%
Potassium	0.44 ± 0.01	1.05 ± 0.02	%
Calcium	0.99 ± 0.08	1.09 ± 0.05	%
Magnesium	0.04 ± 0.00	0.11 ± 0.01	%
Zinc	0.37 ± 0.02	0.26 ± 0.02	%
Organic Carbon	17.70 ± 0.42	23.75 ± 0.88	%
Ash	55.34 ± 2.42	29.53 ± 0.45	%
Ratio C/N	27.4	44.6	-
CRA	241.27 ± 4.35	336.67 ± 23.57	%
CEC	8.43 ± 0.00	43.08 ± 3.26	meq/100g
Moisture	33.76 ± 0.47	43.53 ± 1.38	%
pH	6.67 ± 0.02	6.19 ± 0.01	-
Conductivity	677.00 ± 0.00	1151.00 ± 4.24	µS/cm
Density	0.20 ± 0.02	0.17 ± 0.00	g/cm^3

CEC: The cation exchange capacity, is the parameter that shows the ability that will have the soil conditioner or biofertilizer to deliver the nutrients that possesses to the soil. In the case of Colombia is required as 30 meq / 100 g of soil, and it is fulfilled in the treatment B, however this does not affect the production of the biofertilizer.

Table 3. Microbiological Results of the Samples

	Sludge + Sawdust	Sludge + Coirpit	
Parameter	**Result**	**Result**	**Unit**
Nematodes	Absent	Absent	-
Protozoa	Absent	Absent	-
Salmonella	Absent	Absent	(P/A)
Enterobacter	0.0	1.0×10^3	g
Yeast	0.0	0.0	CFU

The absence of contaminants load such as nematodes, protozoa and salmonella is very important to prevent that it is transmitted to the soil pests or diseases. Again the A treatment with sawdust was which presented lower levels of microbiological load, fact that is reflected in the analysis phytotoxic of the germination of radish seeds with substrate of both treatments, where germination percentage is 100% with respect to the control without probiotics.

CONCLUSIONS

- The levels of heavy metals in the sludge material were reduced to the parameters required by the Colombian authorities.

- The treatment of tannery sludge from the WWTP of Tann Colombia is possible through the addition of a dry material (sawdust or coir pith), implementing a process of composting with PROBIOTICS technology.

- The addition of PROBIOTICS technology, manages to reduce odors present in the sludge.

- The composting process is fast, efficient and economically viable as an alternative for the treatment of this type of hazardous waste.

- The final material can be used as a soil conditioner in projects that are not for the production of food for human and animal consumption.

- After this treatment is concluded that this material is available for landfills and/or reaforestation without causing pollution to the soil and ground water table.