



## **Alkaline Stabilization in a Treatment Plant of Domestic Waste Water: experimentation and microbiologic characterization and parasitological of biosolids**

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**Abstract :** In this paper presents the evaluation of the alkaline stabilization of biosolids results of the operation of a treatment plant of domestic wastewater, to improve the microbiological quality and parasitological. The two alkalizers were evaluated, the cal alive (CaO) and the cal hidratado (Ca[OH]<sub>2</sub>), characterizing two experiments, each one compound by 15% dose and 25% in proportions weight to weight of biosolid duplicated with treatment witness without application of alkalizer, in total ten treatments. The results consider is probable that the period of dehydration of 30 days in advance to the studio helped the low presence of helminth eggs and the power of sanitization of the alkalizing materials.

**Key words :** Biosolids, stabilization, microbiological characterization, waste water.

### **Introduction**

The biosolids are consider as an important source of nutrients like Nitrogen (N) and phosphorus (P), and according to could contain concentrations of toxic chemical substances like heavy metals (arsenic, cadmium, chromium copper, mercury, nickel, lead, selenium and zinc); concentrations that depend on the nature of water discharges in the sewage system<sup>1</sup>. In Colombia the manage and sludge disposal and biosolids generated in treatment plants of sewage water (TPSW) represent a social and ecological problem. The biosolids are a material of a high biological potential, because of the nutrients, and are compound by substances very harmful for the public health cause the toxicity and pathogenicity.

One alternative for the final disposal of the bio solids, is to use them as helpers for agricultural lands, because they have an important source of nutrients for crops, cause of the organic matter, Macronutrients like N, P y K and many micronutrients like Cu and Zn<sup>2</sup>. Although they have less levels of nutrients than the commercial fertilizes (for nitrogen, phosphorus and potassium respectively. Could be used to replace part or all the commercial fertilizers that are in use. We also have seen that the biosolids have properties that make them superior to those fertilizers, like properties of coagulation, of retention of water, and the slow and continuous

release of nutrients<sup>3</sup>. Therefore, once stabilized, these could be used as fertilizers, helpers of the land, or like a cover of landfills. However it is not official a national rule that regulates the secure application of this product and allows incorporate it in the productive and economic cycle and other environmental programs that reduce desertification of soils. This paper considers the evaluation of alkaline stabilization of biosolids generated in the TPSW village of La Calera (Cundinamarca, Colombia), by the Regional Autonomous Corporation of Cundinamarca (C.A.R.), to improve their microbiological and parasitological quality, using Cal alive (CV) and the Cal hydrated (CH) in combinations with the biosolid of 15% and 25% in proportions weight to weight.

## Materials and Methods

The research applied was almost experimental, because it was studied relations cause-effect in conditions of rigorous control of the factors that could affect the experiment of alkaline evaluation in terms of microbiological quality and parasitological. Also according to the time of occurrence of facts and the register of information related with the theme of study, the type of the research applied, was also consider as descriptive, cause allowed to describe some fundamental characteristics of the homogeneous phenomenon.

### Population and Sample.

The research was developed with biosolids of drying beds that the TPSW of the village La Calera, Cundinamarca (Colombia) and the biosolids were taken from the drying bed N°11, when the cycle finished in 30 days<sup>4</sup>. For the development of the study we took a sample composed from the dying bed N°11 at the beginning, and each unit of the experiment at the end, randomly, at a depth of 8cm respectively.

For the alkaline treatment of biosolid were evaluated two alkanixers, the Cal alive (CaO) and the Cal hydrated (Ca[OH]<sub>2</sub>), characterizing two experiments, each constituted by dose of 15% y 25% in proportions of weight to weight of biosolid for duplicate with a witness treatment without applying alkanizer, finalizing with three treatments. The development of the research, had three phases: The first, the preliminary characterization of bio solid, the second, the execution of calcimine of the biosolids in the land according to the dose already exposed and the third about programing and taking the samples for analysis in situ and the laboratory along the time of study that will be in 13 days.

According to the methods consider in the Table 1 and according to the standard<sup>5</sup> and the current rule 40 CFR Part 503 U.S.<sup>13</sup>, with the propose to know the microbiological and parasitological parameters, at this way:

**Table 1. Parameters to evaluate**

Parameter	Frequency	Technique †
<i>Microbiological and parasitological</i>		
<i>E. coli</i> (NMP/gr)	Samples the days 0 y 13	Defined substrate (0202B)
total coliforms (NMP/100gr)	Samples the days 0 y 13	Defined substrate (0202B)
Helminth eggs [HH/2 gr]	Samples the days 0 y 13	NOM 004 SEMARNAT 2002

**Note.** Source: Adaptado de Torres, P<sup>1,5</sup>

## Results

The information base of microbiological and parasitological characterization of mud generated in the treatment plant of sewage water, exposed in the Table 1, consider the content of heavy metals in the mud. The Table 2, shows the results of the physicochemical analysis that were exposed the biosolids used in the studio. According to this we see that the biosolids has a pH of 7,1 units, considering neutral, that indicates that is does not have any problem to be submit to the treatments with Cal alive and hydrated, while the chemical parameters

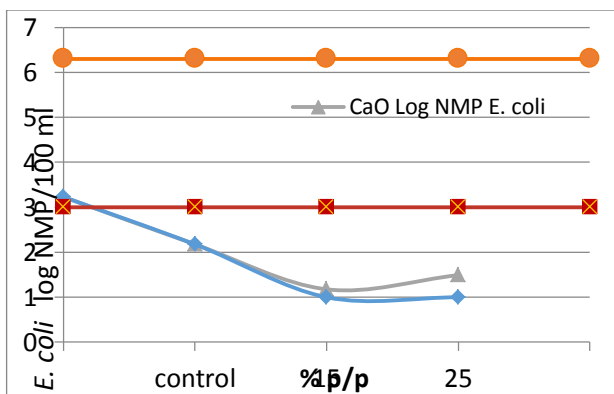
presented concentrations of 1,50%, 1,30% and 0,23% of the total nitrogen, the total phosphorus and potassium, respectively; values very near to the typical range in Colombia<sup>6</sup>. About the total oxidizable organic carbon the concentration of 11,9% is relatively near to 15% recommended by<sup>7</sup> and according to the Agence de L'environnement et de la Maîtrise de L'énergie<sup>12</sup>, the relation C/N is in the range for biosolids of PTAR.

**Table 2. Characterization of biosolids.**

Parameter	Units	Result	Analytic Method
<b>Microbiologics</b>			
<b>Total coliforms</b>	NMP/100 ml	>2,4E+06	Sustrato Definido(9223 B)
<i>E. coli</i>	NMP/100 ml	1,0E+03	Sustrato Definido(9223 B)
<b>Parasitological</b>			
<b>Helminth eggs</b>	HH/2g PS	60	NOM-004-SEMARNAT-2002

Source: The authors.

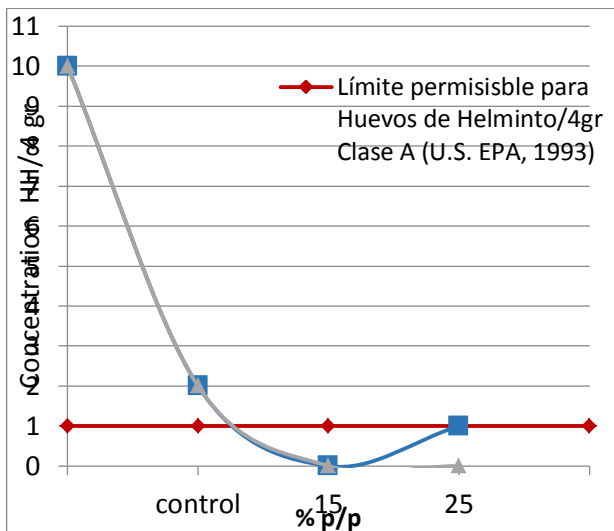
The effect of the alkalizes was evaluated about the bacteria that indicates the fecal contamination, *Escherichia coli*, to determine the recommendable dose for the inactivation of this concentration in a constant time of 13 days. In the figure 1 is visible the initial concentration (day 0) in the control treatment is 3,2 logarithmic units accomplishing the entrance with the condition require by the U.S EPA at least of 6 log for the biosolids Type B, however in the time of the study in the control is visible a reduction of 1,1 logarithmic units. Likewise, with the treatments with the alkalizer is visible that with the dose of 15% and with the 25% of  $\text{Ca}(\text{OH})_2$  is possible to remove 2,2 logarithmic units, this became a remotion efficiency of 99,14% a similar result obtained with a treatment of 15% of  $\text{CaO}$  (2,1 units log), is according with the last reported by<sup>8,9</sup>, where there was a reduction of 3 logarithmic units lower the limit required for biosolids Type A. According to this results is important that even this indicator was low in the witness treatment is probable that without the application of the alkalized the concentration of it stay present an overgrowth during the time of storage.



**Fig. 1. inactivation of *E. coli* contained in the biosolid treated with different dose of  $\text{CaO}$  y  $\text{Ca}(\text{OH})_2$ .**

Source: The authors.

In the figure 2 is visible the initial concentrations of helminth eggs of biosolid with an average of 10 HH/ 4 gr PS, after the period of study is visible an efficiency of remotion of 80% (2 HH/ 4gr) without application of alkalizer, but the alkalization with dose of 15 and 25% of  $\text{Ca}(\text{OH})_2$  could get efficiency of 100%, the similar case occurs with the  $\text{CaO}$  according to the maximum limits of U.S EPA (1993)<sup>13</sup>.



**Fig. 2. Inactivation of helminth eggs contained in the treated biosolid with different dose of CaO y Ca(OH)<sub>2</sub>.**

**Source: The authors, 2012.**

In previous studies, several researchers<sup>9,10,15</sup> could obtain biosolids type A, with an equal or superior dose to 25% of CaO, even when this contain high initial concentrations of helminth egg, in times of minimum contact or even higher to 13 days. In this order of ideas although the initial concentrations of helminth eggs in the biosolid of the PTAR of La Calera are relatively not too high, the results allow to know that the dose of 15% of CaO is very probable to obtain reduction grades of 100% keeping the values of pH >12 units during 13 days, even accomplish the requirements of temperature, noticing the same with the report by Mignotte-Cadiergues<sup>10</sup>, cause it was found that the el pH of 12 units during 7 days is relevant in the optimization of microbiological quality of the solid mud. At the same way is important that according to this studio is possible to obtain, with dose at least 15% of Ca(OH)<sub>2</sub>, efficiency of remotion similar to the others got with the CaO. According to these results is probable that the period of dehydration of 30 days previous to the studio help the lack presence of helminth eggs and of course the power of sanitization of alkalizing materials, cause in the studio made by<sup>11</sup> with dose of Ca(OH)<sub>2</sub> of 40 and 60% and an initial concentration of 1100 eggs of helminth / 4 gr PS did not get the total reduction in this indicator also with values of pH higher to 12 units during a month.

The results obtained noticed that with a dose fewer to 25% of cal, and with characteristics presents by the biosolid (aerobic digestion, conditions and high degree of dryness, 71,3%) is possible to reduce the content of pathogen that allow to obtain a biosolid Type A suitable to several uses that approves this category even in fewer days of contact. The results of Pegorini et al., (2006) prove the last result because it was found that the correction of mud with Cal occurs with low content of humidity, also found that the drier sludge (49 and 60% ST) require less dose of Cal for the alkalization and the maintenance of a high pH. According to this we see the effect that has the dose of 15% p/p de Ca(OH)<sub>2</sub> in the inactivation of *E. coli* with 2,2 logarithmic units removed, and the 100% of remotion of helminth eggs approximately.

## Conclusions

During the alkaline stabilization could define that the two types of Cal used could go up and keep the pH of the mixture in higher values to 12 units during the time of study, helping the inactivation of fecal contamination indicators evaluated (*E. coli* and helminth eggs) even without accomplishing the temperatures recommended, this alkaline condition reinforce the disinfectant power of ammonia gas (NH<sub>3</sub>) obtained in the ion conversion NH<sub>4</sub><sup>+</sup>. The treatment of biosolid with dose of 15% of hydrated Cal (Ca[OH]<sub>2</sub>), accomplishing the previous period of dryness in a month, got better results about not modifying extremely the content of organic matter and macronutrients (N, P y K) and accomplish the maximum values of humidity recommended for organic amendments for the<sup>7</sup>. Although the alkaline stabilization is a process that stabilizes the organic matter producing biosolids with nutrients that make them suitable for reuse as conditioner of soils, present a disadvantage that increases the concentration of total soils and high values of pH that limit the use in the land,

with problems of alkalinity, however would improve the characteristics of the acid soil as reported in several studios.

## Acknowledgements

The authors thank the Regional Autonomous Corporation of Cundinamarca (CAR), [14] CONHYDRA S.A. and the academic program of Specialization in Water and Environmental Sanitation Manuela Beltran University for the support and collaboration in the preparation of this manuscript.

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