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EFFECTS OF ELECTROCHEMICAL TREATMENT ON MICRO-ORGANISMS IN SWINE STORED SLURRY: SOME EVIDENCES

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ABSTRACT

In the frame of E.U. FAIR CT 97-3506 research project, the efficiency of the electrochemical treatment was studied, investigating the microbial content of the slurry and the air above the storage tanks. Pig slurry was treated in PVC tanks of 0.816 m^3 capacity and an electric current of 1.0 A was maintained between couples of copper and graphite electrodes. Untreated slurry was stored at the same conditions of the treated ones.
Proteolytic, cellulsolytic, ammonifying, and *Clostridium perfrigens* were monitored in the slurry, while the heterotrophic aerobic and anaerobic total counts were monitored in the air. Coliform bacteria were monitored as indicator of pathogen micro-organisms both in the slurry and in the air.
In the slurry the anaerobic micro-organisms content did not show any statistically significant change during the trial, the aerobic heterotrophic micro-organisms and coliform bacteria significantly decreased ($P<0.1\%$). Nevertheless, in all the cases no significantly different behaviour could be observed when compared with the untreated slurry.
As regards the micro-organism release in the atmosphere, the treatment with couple of copper electrodes resulted effective in reduction of aerobic heterotrophic micro-organisms ($P<5\%$) and coliform bacteria. On the contrary, the anaerobic heterotrophic micro-organisms proved to be more sensible to the treatment with couple of graphite electrodes ($P<5\%$).
In conclusion, the electrochemical treatment did not influence the proliferation of the micro-organisms in the slurry and their vitality, but it did influence the release of micro-organisms from the surface of the storage tanks.

INTRODUCTION

In solid manure obtained from animal houses which use litter materials, pathogens are generally defeated by the high temperature produced by the metabolism of the saprophyte micro-organisms during storage.
In modern management the litter materials are eliminated from the shelters of the livestock, thus achieving a shortening of the storage period. In the slurry obtained a cold anaerobic fermentation takes place that allows the pathogens to survive. The aerosol from the surface of the storage tanks is an air contamination vehicle and the pathogens are able to be spread in to the environment by fog and wind. Nowadays the treatment of the slurry during storage must be focused to the improvement of its hygienic quality. Traditional treatments have some limits: aerobic treatment promotes the aerosol process, while anaerobic treatment is very expensive for the quantity of thermal energy required.
Alternatively an electrochemical treatment can be utilised. The low electric power applied and the release of metal ions modify the physical and chemical characteristics of the slurry and sensibly reduces the gaseous emissions (Chiumenti *et al*., 2001).
The E.U. FAIR CT 97-3506 Project was aimed to study the efficiency of the electrochemical treatment, investigating the microbial content of the slurry and the air above the storage tanks.

MATERIALS AND METHODS

Pig slurry (0.650 m^3) was treated in PVC tanks of 0.816 m^3 capacity and the electric field was obtained by the immersion of couples of electrodes. Untreated slurry (as a control) was stored at the same conditions as the treated ones.

The trial was carried out in summer conditions with copper and graphite electrodes, electric power intensity of 1 A, inversion time 240 sec, for 60 days.

In order to investigate the evolution of cold anaerobic fermentation in the slurry, some anaerobic micro-organisms were monitored at the beginning, and at the end of the trial:: anaerobic proteolytic micro-organisms, anaerobic cellulsolytic micro-organisms, anaerobic ammonifying micro-organisms, anaerobic heterotrophic micro-organisms (monitored also on day 30) and *Clostridium perfrigens*. (monitored also on day 30). Aerobic heterotrophic micro-organisms were also monitored.

In order to investigate the hygienic quality of the exhaust air from the pilot tanks, some microbial groups were monitored at the beginning, after 30 days and at the end of the trial: anaerobic heterotrophic micro-organisms, aerobic heterotrophic micro-organisms and *Clostridium perfrigens*.

Moreover, Coliform bacteria were monitored both in the manure and in the air as indicator of pathogen micro-organisms.

Bacteria in the slurry and from the air (sampled by the SAS 90 sampler) were grown in selective medium (MPN and UFC methods). The data obtained were submitted to statistic analysis (Anova completely randomised).

RESULTS

<u>SLURRY</u>

In the slurry the number of aerobic heterotrophic micro-organisms was significantly lower (P<0.1%) both on day 30 and day 60 for all the theses in comparison of the number found at the beginning of the trial (fig.1)

The anaerobic micro-organisms content did not show any statistically significant change during the trial (fig. 2). The coliform bacteria showed a decreasing trend (fig. 3).

Clostridium perfrigens was never found in the slurry during monitoring periods.

Anyway is important to stress that all cases did not show any significant difference between treated manures and in comparison to the untreated one.

Fig. 1: Aerobic heterotrophic micro-organisms in the slurry during the treatment (at the beginning, after 30 days, at the end).

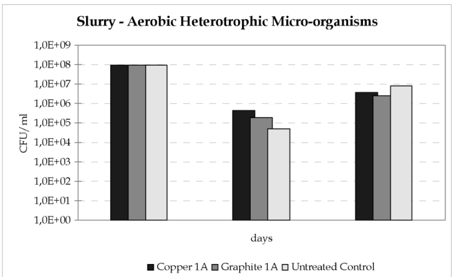


Fig. 2: Anaerobic heterotrophic micro-organisms in the slurry during the treatment (at the beginning, after 30 days, at the end).

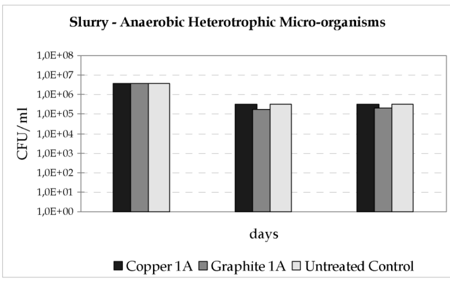


Fig. 3: Coliform bacteria in the slurry during the treatment (at the beginning, after 30 days, at the end).

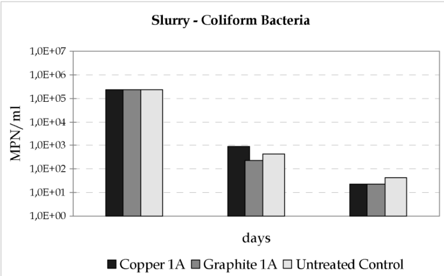


Fig. 4: Anaerobic proteolytic micro-organisms at the beginning and at the end of the treatment (at the beginning, after 30 days, at the end).

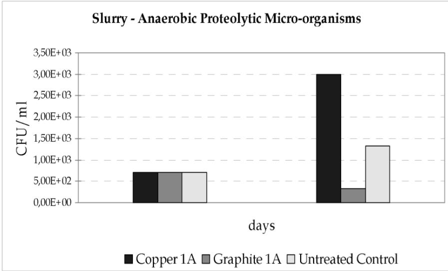


Fig. 5: Anaerobic ammonifying micro-organisms at the beginning and at the end of the treatment (at the beginning and at the end).

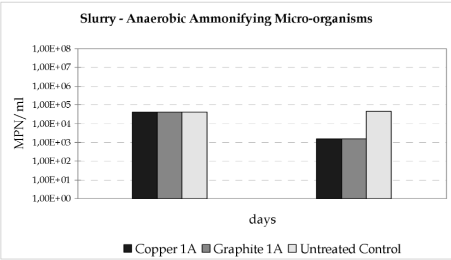


Fig. 6: Anaerobic cellulolytic micro-organisms at the beginning and at the end of the treatment (at the beginning and at the end).

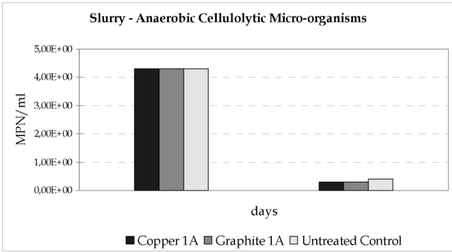
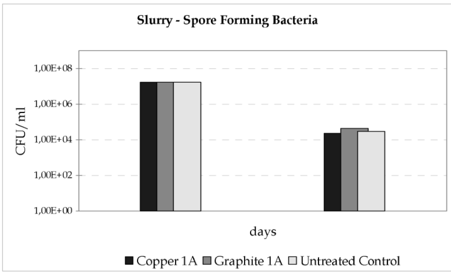


Fig. 7: Spore forming bacteria at the beginning and at the end of the treatment (at the beginning and at the end).



<u>AIR</u>

Concerning the of micro-organism release in the atmosphere the different theses showed a general increasing trend during the trial.

The materials of the electrodes seemed to produce different effects on different heterotrophic groups: the treatment with couple of copper electrodes resulted effective to aerobic heterotrophic micro-organisms (P<5%), the anaerobic heterotrophic micro-organisms proved to be more sensible to the treatment with couple of graphite electrodes (P<5%), while Coliform bacteria were significantly reduced both with copper and graphite electrodes.

Clostridium perfrigens as happened in the slurry was never found.

Fig. 8: Aerobic heterotrophic micro-organisms in the air during the treatment (at the beginning, after 30 days, at the end).

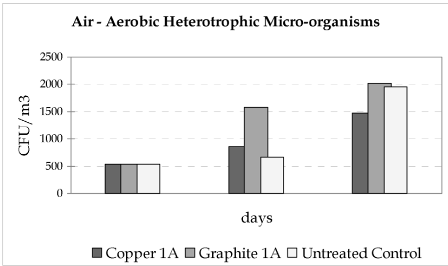


Fig. 9: Anaerobic heterotrophic micro-organisms in the air during the treatment (at the beginning, after 30 days, at the end).

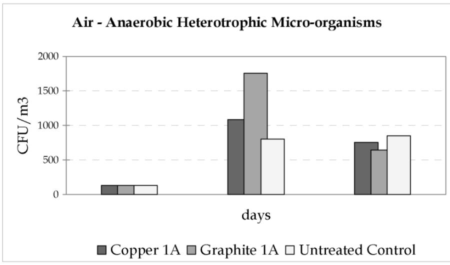
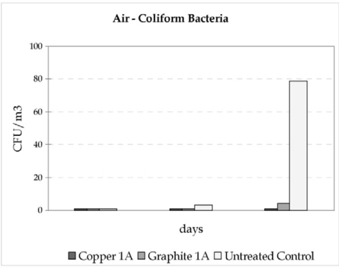


Fig. 10: Coliform bacteria in the air during the treatment (at the beginning, after 30 days, at the end).



DISCUSSION

Electrochemical treatment did not influence the proliferation of the micro-organisms in the slurry and their vitality. The cold fermentation seemed to evolve equally in treated and untreated slurries. On the contrary, electrochemical treatment seemed to influence the airborne bacteria emission from slurry. The release of the different microbial groups was strongly influenced by the electrodes used (copper or graphite). The phenomenon could be explained by modifications of the manure physical characteristics. (i.e. reduction in the stratification of the suspended solids in the manure) as previously described by Chiumenti et al. (1993). However, the specific mechanism of action of electrochemical treatment in the modification of the manure physical characteristics is not sufficiently clear and it should be studied by further research. Nevertheless, the research supplied some encouraging evidences and starting points to improve the hygienic quality of the air during the storage of slurry.

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