# ANAEROBIC TREATMENT OF PHENOL IN A CONTINOUS FLUIDIZED-BED BIORREACTOR

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## Summary

Between 85% to 95% of phenol and 90% to 100 % of organics acids was effectively degraded in an anaerobic continous fluidized-bed bioreactor (RALF), with a 6 hours of hydraulic retention time, for a synthetic wastewater containing until 600 ppm of phenol and 500 ppm of acids. Influent and effluent composition was measured by gas chromatography GC-TCD, GD-FID and TOC. The test showed high efficiency in phenol treatment in a RALF, obtained the kinetic constant of phenol degradation of 0.0012 L/mg·day (considering a first order reaction).

**Keywords**: biodegradation, anaerobic treatment, fluidized-bed biorreactor, phenol.

## 1. Introduction

In anaerobic digestion most of the organic compounds are degrade by the action of a wide variety of microrganisms (usually bacteriums) in oxygen absence and other oxidant agents. $CH_4$ and $CO_2$ are the most significant products of degradation [1].

Phenol is a common pollutant of many industrial effluents from chemical operations. In this study, degradation of phenol has been done in a fluidized-bed bioreactor (RALF) [2] by the addition of increasing concentrations next to the feeding point.

## 2. Materials and methods

A mixture of acetic, propionic and butyric acids -2:1:1 until 500 ppm in TOC- were used as the only source of carbon to feed the reactor. Macro and micronutrients were supported in relation 100:7:1 in C:N:P, and its composition was based in the use of Evans minimum middle. Next was increased the phenol concentration until 600 ppm. During de continuous period, the reactor was feeded with a synthetic wastewater, varying the TOC concentration from 500 ppm until 1100 ppm with 6 hours of hydraulic retention time.

It was measured the feeding flow (L/day), gas flow (L/day) gas composition [$CH_4$ and $CO_2$ (mM) by gas chromatography GC-TCD] and influent-effluent composition (acids and phenol by gas chromatography GD-FID and TOC in a TOC Analyzer).

## 3. Results

Percents of final phenol degradation vary from 85% to 95%, getting smaller values when increasing its concentration. To obtain the kinetic constant of phenol degradation (Figure 1), it has been supposed a first order kinetic reaction, obtaining a result of 0.0012 L/mg·day.

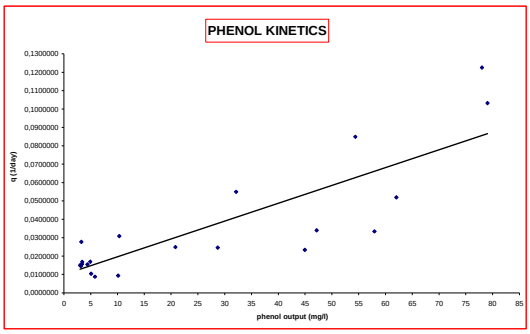


**Figure 1:** Kinetic constant of phenol degradation

Removal efficiency of acid degradation was about 90% in TOC and DQO, sometimes 100% with 6 hours of hydraulic retention time. TOC evolution shows three stages corresponding to the start-stage of the reactor, a stationary phase and phenol incorporation to the feeding (Figure 2).

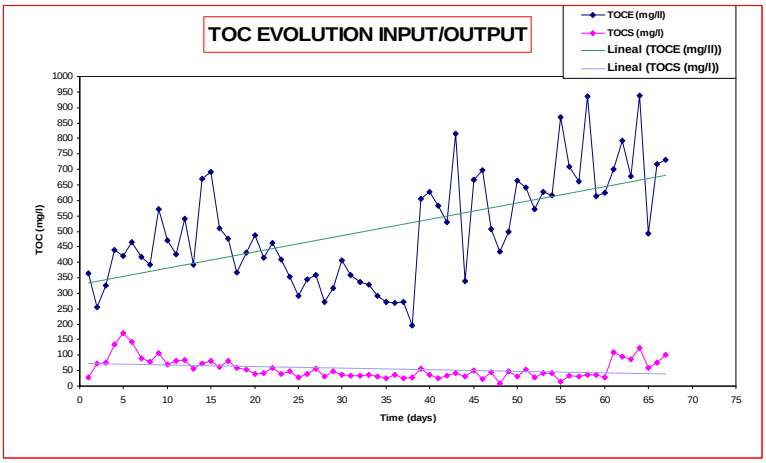


**Figure 2:** TOC evolution input/output in reactor

## 4. Conclusions

1. Fluidized-bed biorreactor shows high efficiency in phenol treatment, reaching removal efficiency until 100% sometimes, instead they usually vary from 85% to 95% (so high values considering 6 hours of time retention and a no-adapted sludge).
2. Illustration of kinetic reaction fits to a straight line, which shows the reaction occurs in a low-amount-zone of substrates, considering a first order reaction with K=0.0012 L/mg·day.

## 5. References

[1] H.H.P. Fang, D.W. Liang, T. Zhang and Y. Liu (2006). **Anaerobic treatment of phenol in wastewater under thermophilic condition**. Water Research, Volume 40, Issue 3, Pages 427-434.

[2] Speece R.E., (1996). **Anaerobic biotechnology for industrial wastewaters**. Archae Press, Nashville, USA.