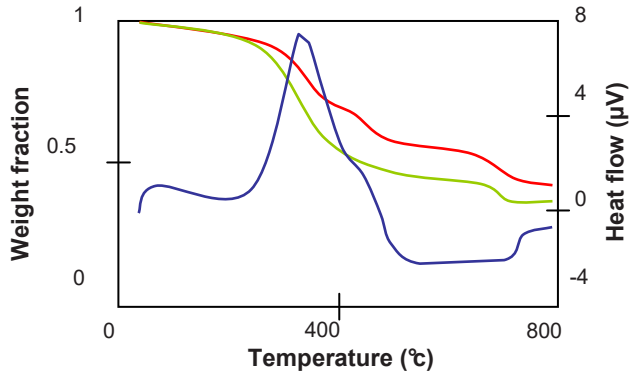
Analysis of sewage sludges by thermogravimetry

INTRODUCTION

The sewage sludge is the principal waste produced by a sewage treatment plant: One cubic meter of domestic wastewater gives, after treatment, 350 to 400 grams of sludge (solid waste). It especially consists of dead bacteria and mineral-bearing organic matter. These last years, the production of sewage sludge strongly increased. For example, European Union generated 10 million tons approximately of matter dries in 2005. However, sewage sludge disposal raise a problem. As some harmful components prevent spreading, other techniques like pyrolysis, gasification and combustion, are considered. Therefore, the aim of the publication was to predict the sludge behavior in combustion or pyrolysis by thermogravimetric analysis and determine, from that, the parameter PII/(PI+PII).



TG curves of a sludge sample
Combustion
Pyrolysis
Heat flow of combustion

The parameter **PII/(PI + PII)** shows the influence of proteins in the decomposition of sludges. **PI** represents the weight loss influenced by the decomposition of structural carbohydrates. **PII** represents the weight loss influenced by the decomposition of proteins.

EXPERIMENT

The following procedure is used to analyze sludges:

• **TG analysis:** BSA protein was analyzed by TG and GC (elemental analysis) to compare its behavior with the behavior of sludges.
Then, experiments were carried out with a THEMYS STA at a heating rate of 10°C/min from 25 to 700°C. Sludge samples (5mg) were analyzed under two different atmospheres: helium to obtain pyrolysis or helium (80%) + oxygen (20%) to obtain combustion. In the second case, a DSC curve is also plotted to know the temperature of combustion. For all experiments, the gas flow was 60mL/min.

• **Parameter PII/(PI + PII):** This parameter is calculated thanks to the TG curves of combustion.
PI was obtained by measuring the difference of sample weight between 100 and 300°C in the curve and PII between 350 and 600°C.

RESULTS AND CONCLUSION

Below 200°C, the loss of weight is small and the heat flow is about 0µV.
Between 200 and 700°C, three different behaviors were observed according to the relative position of combustion and pyrolysis curves.
The final residue at 700°C is 0.3-0.6 for pyrolysis and 0.2-0.55 for combustion.
Then, it is possible to connect the behavior observed on the curves to the value of PII/(PI+PII). The first behavior corresponds to a value of this parameter lower than 0.40. A value between 0.40 and 0.47 is associated to a second type and a value greater than 0.47 represents the third behavior.

Reference: ASTM E1641-13 Standard test method for decomposition kinetics by thermogravimetry using the Ozawa/Flynn/Wall method.

For more details ask for publication A0605

INSTRUMENT

THEMYS STA

ACCURATE AND SENSITIVE ULTRA-HIGH TEMPERATURE
heat flow measurement with Tri- Couple DTA technology

ULTRA-HIGH TEMPERATURE CAPABILITY
to 2400°C with a single furnace.

MODULAR ADAPTIONS ALLOWING
TGA only, DTA only, TG-DTA, and TMA up to 2400°C, DSC only and TG-DSC up to1600°C all in one instrument

HIGH ACCURACY & VERSATILITY
hang-down symmetrical beam balance, specifically designed for TGA applications

EXTERNAL COUPLING CAPABILITY
designed for evolved gas analyzers (FTIR, MS, GCMS, MSFTIR, or FTIR-GCMS)