

# PRELIMINARY RESULTS IN OZONE/PERCARBONATE SLUDGE TREATMENT TO ENHANCE VOLATILE FATTY ACIDS GENERATION

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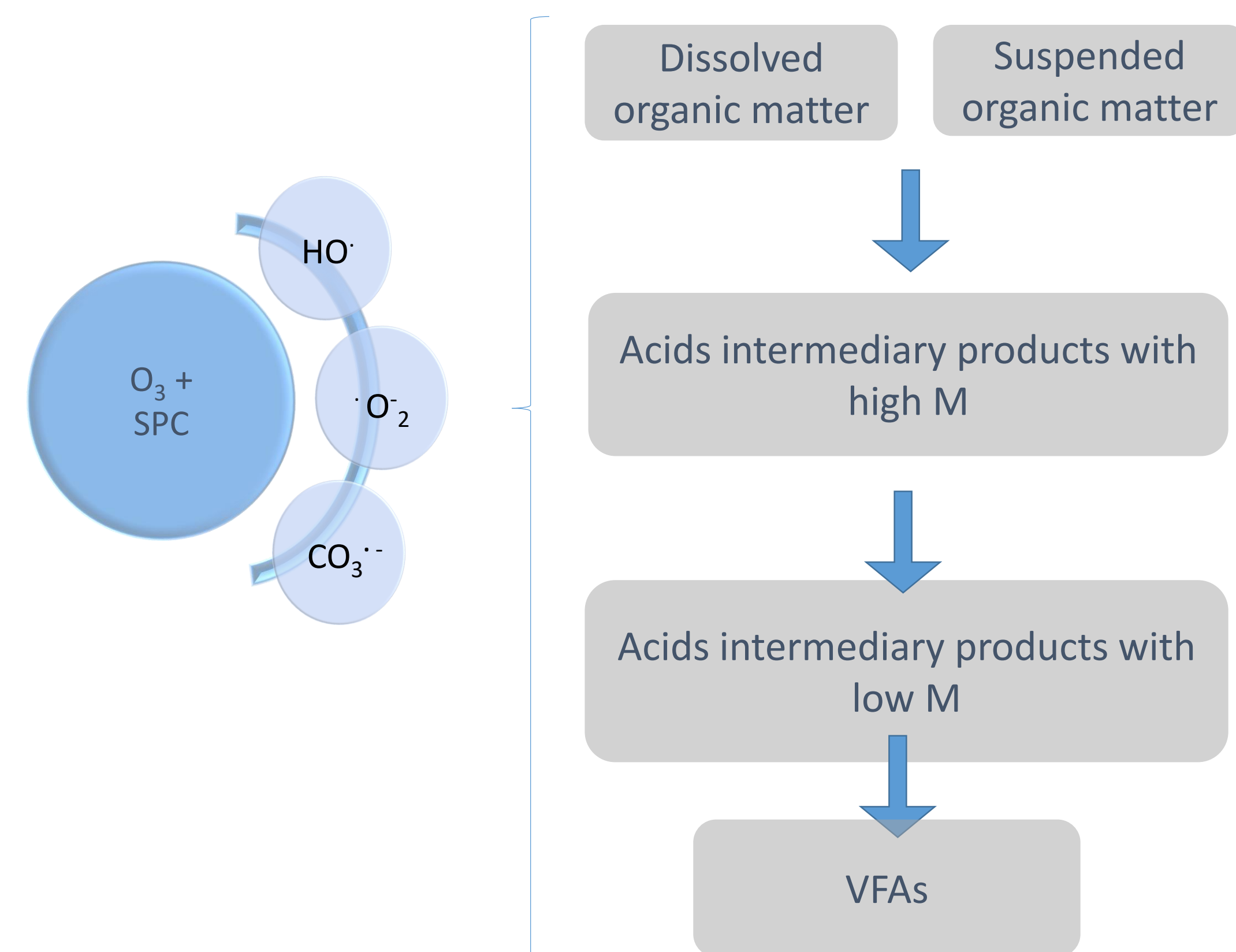
## Introduction

The aim of the study consists in residual sludge treatment by oxidation with ozone and percarbonate for enhancing the generation of volatile organic acids known as volatile fatty acids (VFA). These compounds are essential in some industrial processes and are also intermediary degradation products of organic matter.

The viability of the process was established by vary the oxidants doses applied to sludge samples in continuous stirred tank reactor, at laboratory scale. It is interesting to correlate the VFAs generation after direct oxidation with soluble fluorescence intermediary products in order to analyse the efficacy of different oxidation systems.

## Materials and methods

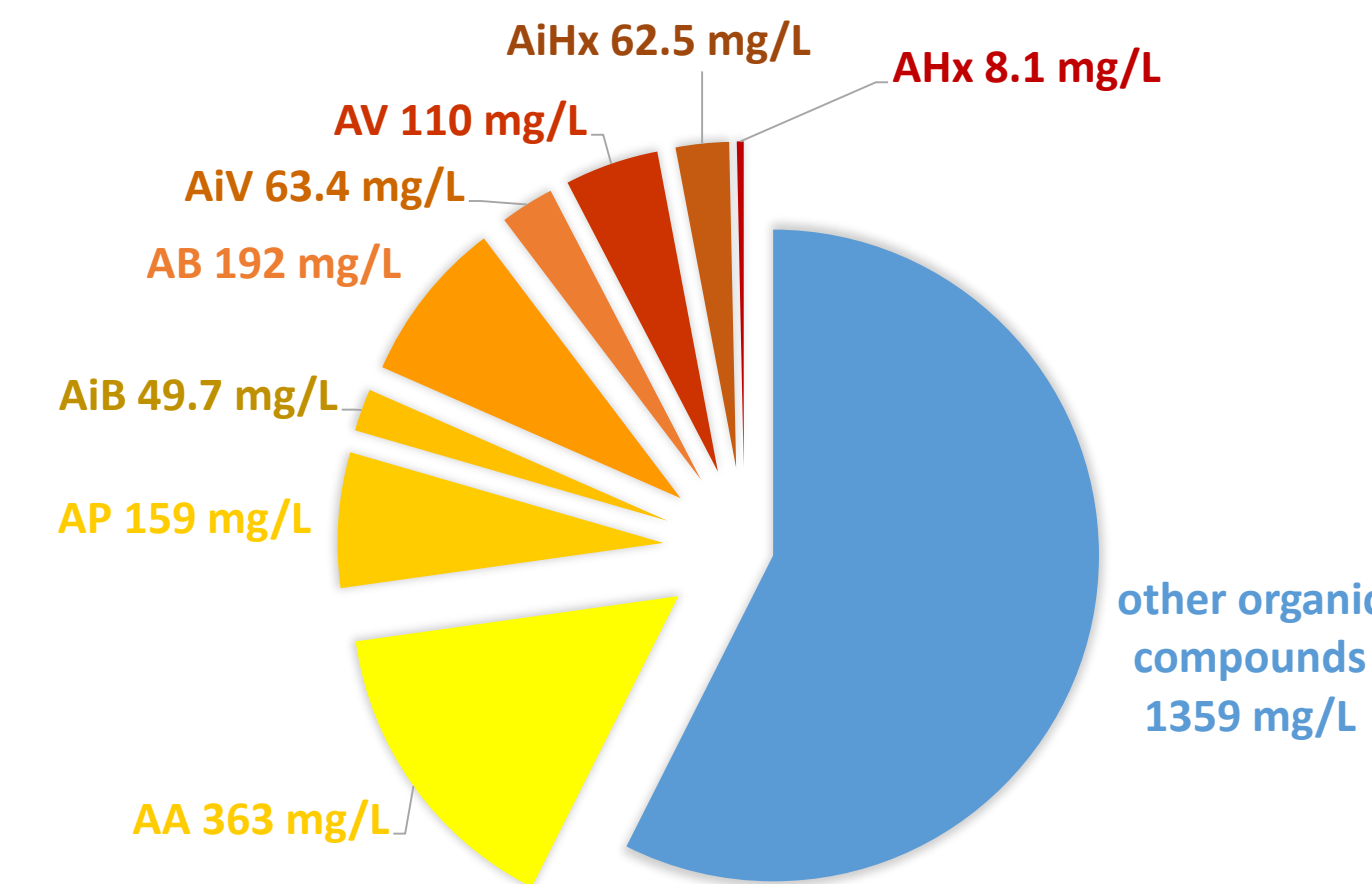
- Sample: waste activated sludge (WAS)
- Volatile fatty acids (VFAs) - GC-FID, Agilent 6890N
- Fulvic and humic acids compounds *like* - Clariostar fluorimeter
- Elemental composition - Rigaku NEX CG X-ray
- Particle dimension - Malvern Mastersizer 2000
- Advanced Oxidation Process – ozonation + sodium percarbonate (SPC)



## Results and Conclusions

### Sludge Characterisation

- VFAs sum represents 42.4% from the dissolved total solids and 8.15% of sludge total COD

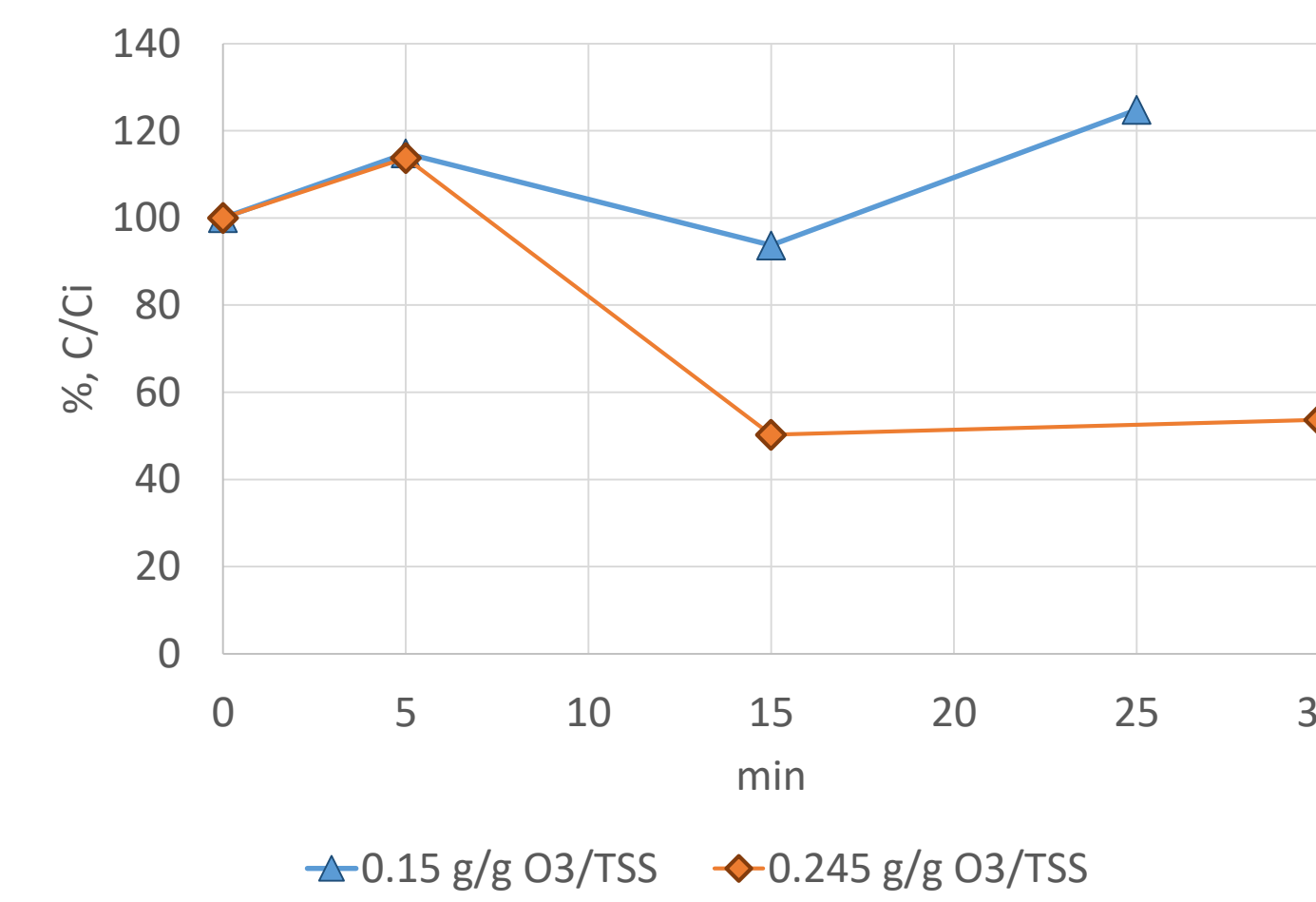


**Graph 1** Volatile fatty acids content in supernatant of untreated WAS after centrifugation (10000 RPM)

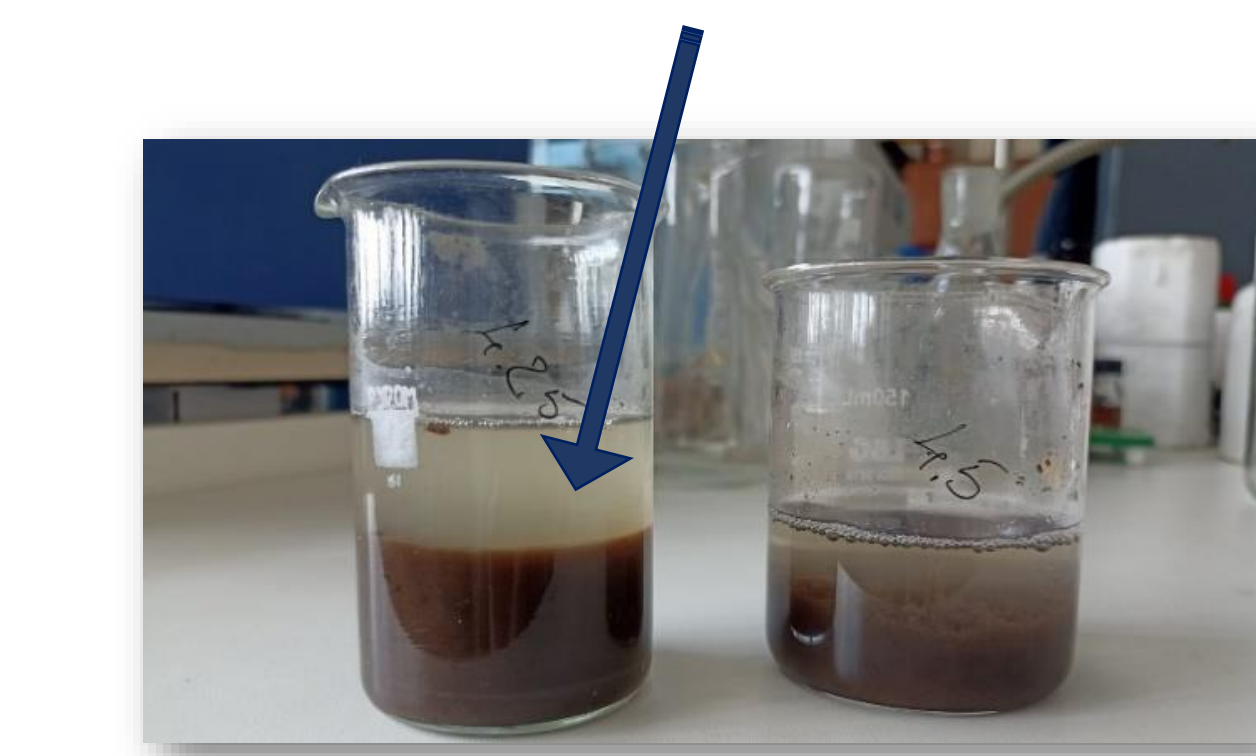
### Critical operational parameters

#### Ozone dose

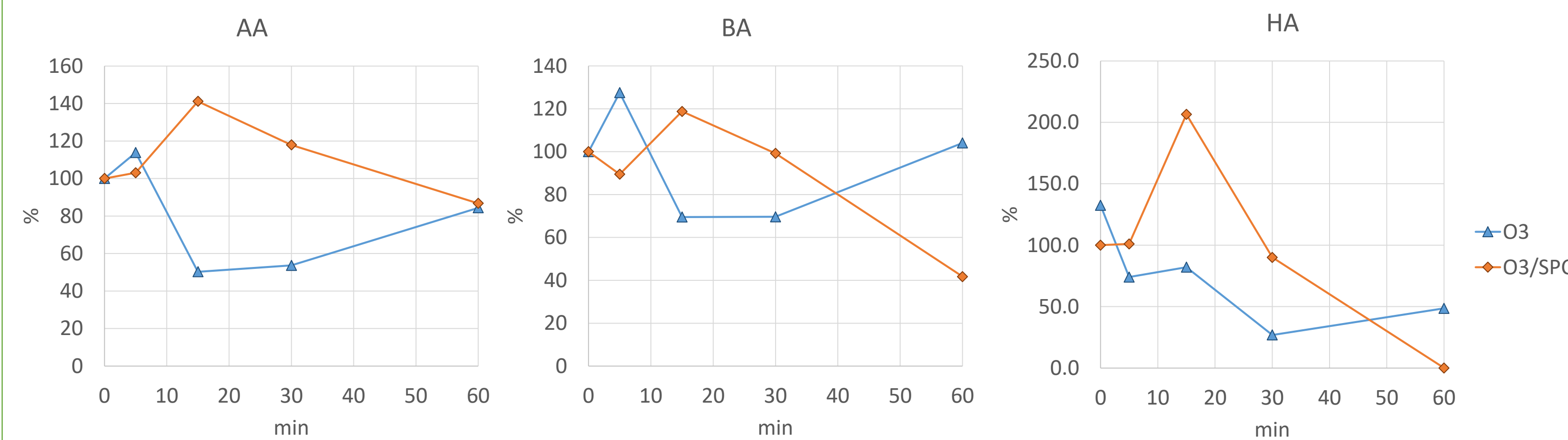
- Higher ozone dose decreases the VFAs concentration for the first 30 minutes, as acetic acid example on the right.
- Also, high O<sub>3</sub> concentration impacts more severely the extracellular matter formation and colloidal matter increase. Still, the sludge separation is better defined.



**Graph 2** Percentage ratio of acetic acid concentration vary with reaction time for alkaline ozonation systems



#### Percarbonate addition



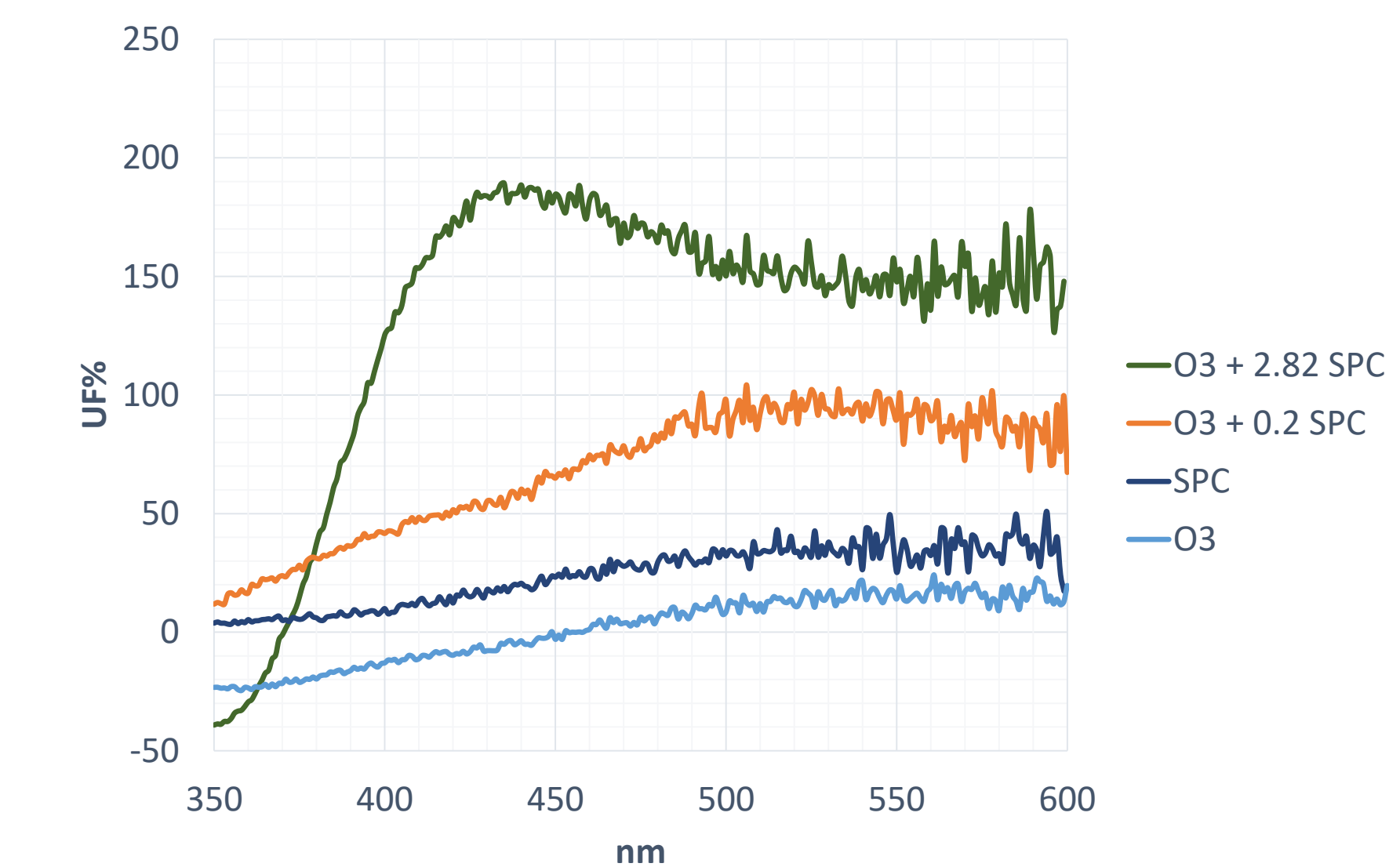
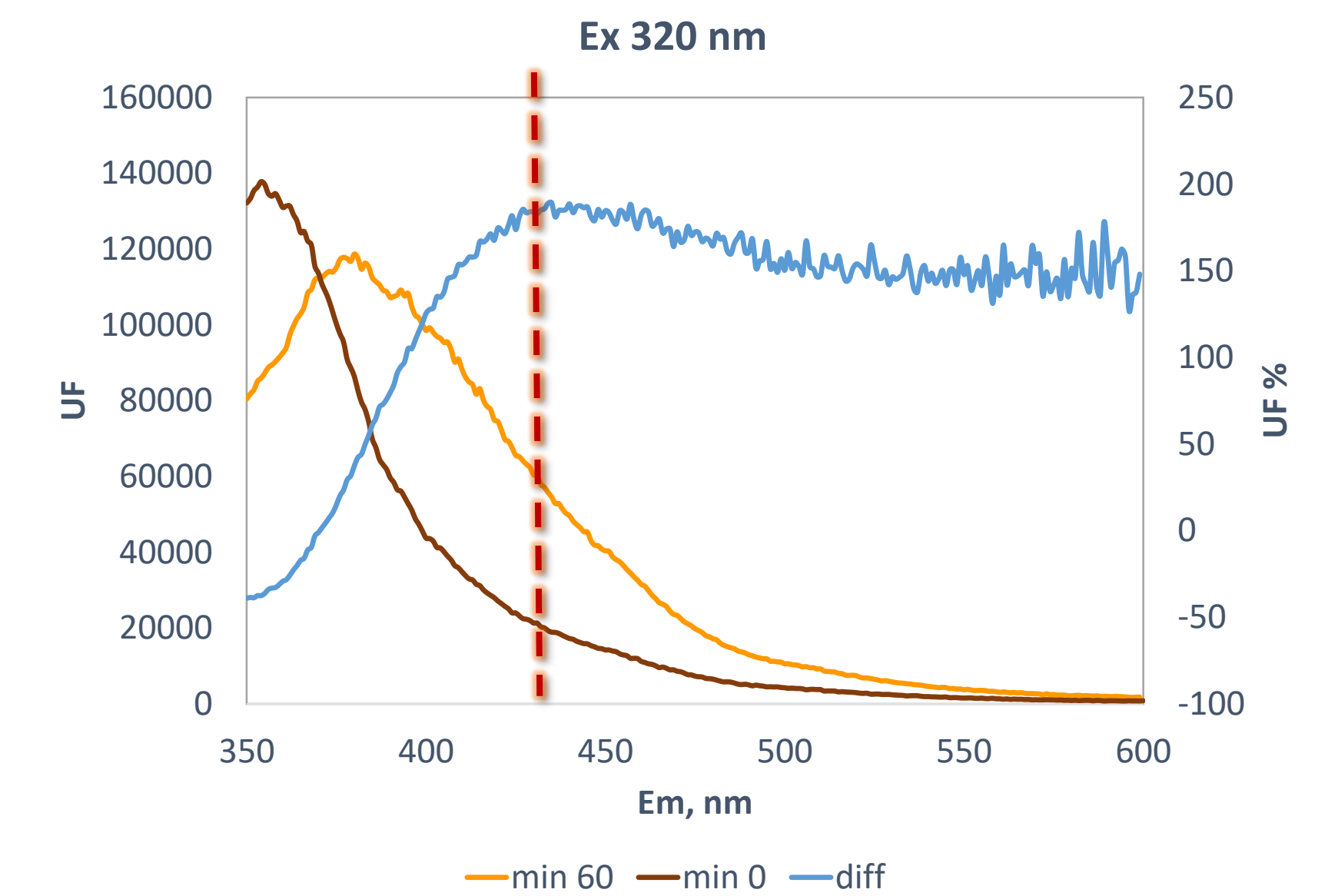
**Graph 3** Percentage ratio of acetic acid (AA), butyric acid (BA) and hexanoic acid (HA) concentrations during 60 min oxidation in alkaline ozonation and ozone/percarbonate (0.21 g SPC/g TSS) oxidation of the sludge (1.2% dry mass) compared with untreated initial sludge

Excitation/emission	Compounds type	Increase
320/376-380 nm	VIS-fulvic acid-like	180%
350/445 nm	UVC-humic acid-like	584%
380/555 nm	VIS-humic acid-like	254%

**Table 1** Main class compounds determined from fluorescence spectra after analysis of sludge treated sample with O<sub>3</sub> and SPC. The increase is the percentage ratio between components fluorescence intensity at 60 min and 0 min

**Graph 4** The spectra percentage difference (UF%) at excitation 320 nm for O<sub>3</sub>/SPC system and hybrid with 0.2, respectively 2.82 g/g SPC/TSS, after 60 min oxidation.

- The red dotted line represents the maximum peak of difference spectra. At ex 320/em 445 nm it is revealed the formation of new fluorescence products after 60 min oxidation.

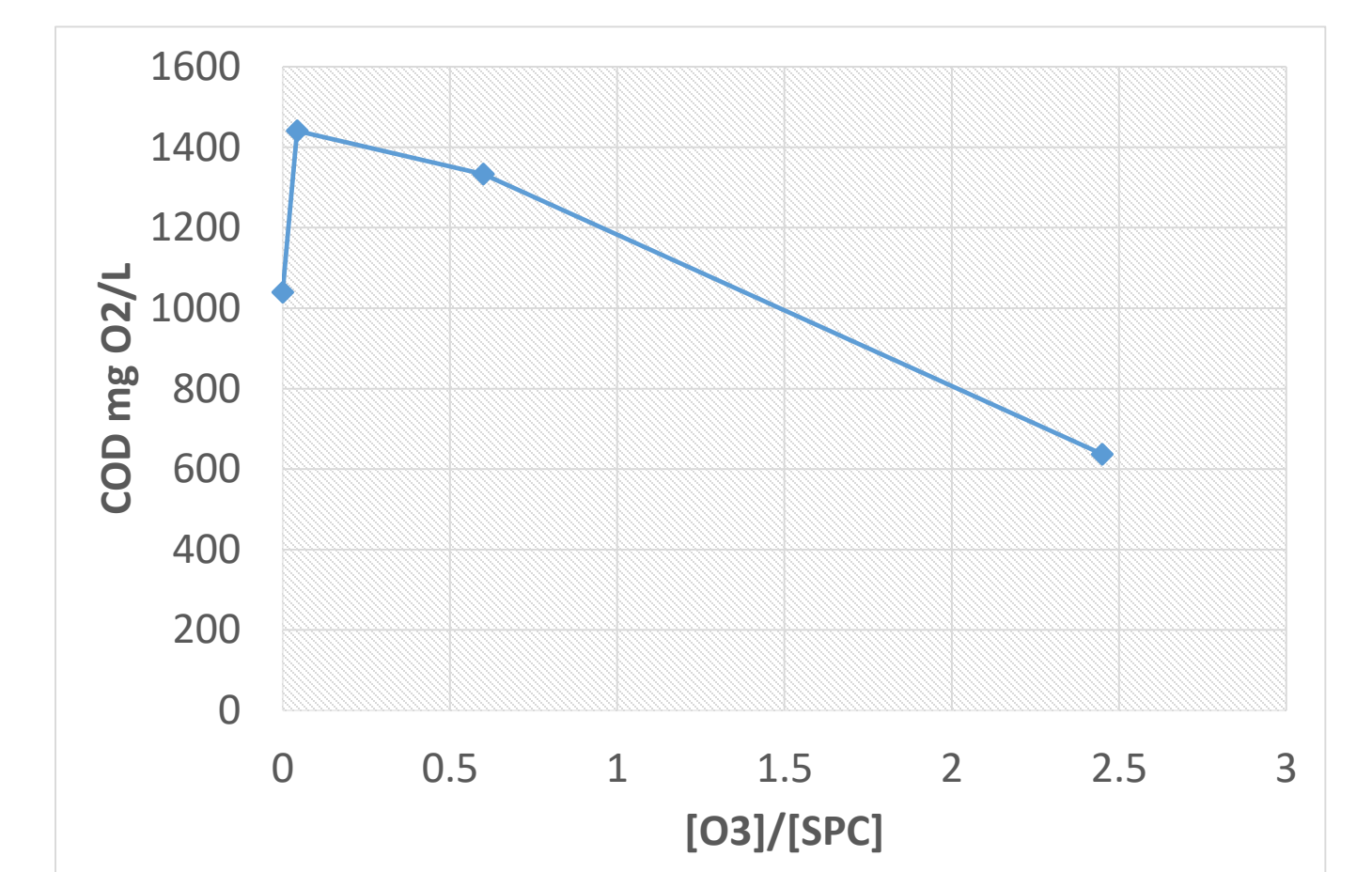


**Graph 5** Percentage fluorescence intensity (UF%) resulted as a difference of 60 min treated and untreated scan spectra of sludge, for different oxidation systems: O<sub>3</sub>, SPC and hybrid with 0.2, respectively 2.82 g/g SPC/TSS excitation 320 nm.

#### Ozone - percarbonate ratio

**Graph 6** VFAs content variation (expressed as COD) for different O<sub>3</sub>/SPC molar ratio, at 60 min oxidation

- At ratio 0.6 (0.2 g/g SPC/TSS) the VFAs concentration is enhanced with 36%.



Aftermath, the factors analyzed in this work fitted the purpose of establishing the framework conditions of combined oxidation system. Further studies should determine if the critical factors weighting encompasses the results plethora or emerges to a common pattern in oxidation processes of industrial sludge complex matrix.

## Acknowledgement

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