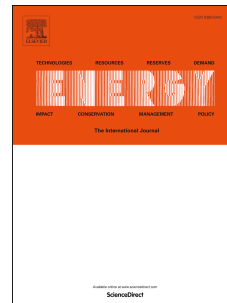


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## Energy and exergy analyses of sewage sludge thermochemical treatment

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### ABSTRACT

The aim of this research was to provide a methodology for calculating the energy and exergy balances for the thermochemical treatment of sewage sludge. The results of the balances were assessed and compared for three different scenarios (torrefaction, pyrolysis and pyrolysis combined with catalytic post-treatment of the vapors). The balances were calculated based on previously published experimental data and evaluated under different conditions. The results indicated that the endothermicity decreased with the severity of the process. The energy recovery from the products favored the exothermicity of the processes. The three-step process (pyrolysis of torrefied sewage sludge combined with catalytic post-treatment of the hot vapors) was the least exergy efficient scenario.

**Keywords:** Torrefaction; Pyrolysis; Catalytic post-treatment; Sewage sludge; Energy balance; Exergy balance.

### Nomenclature:

AP: aqueous phase.

$C_p$ : specific heat capacity at constant pressure,  $\text{MJ}\cdot\text{kg}^{-1}\cdot\text{K}^{-1}$ .

$e$ : specific exergy,  $\text{MJ}\cdot\text{kg}^{-1}$ .

$h$ : specific enthalpy,  $\text{MJ}\cdot\text{kg}^{-1}$ .

$h_{\text{vap}}$ : specific enthalpy of evaporation  $\text{MJ}\cdot\text{kg}^{-1}$ .

HOP: heavy organic phase.

LOP: light organic phase.

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