

# Energy-efficient wastewater treatment in a two-stage activated sludge process

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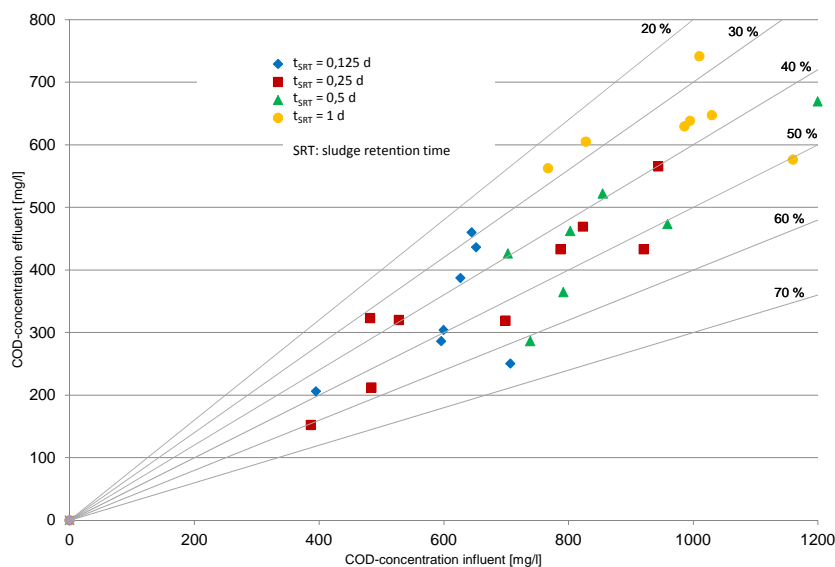
Keywords: renewable energy, municipal wastewater, wastewater treatment, energy efficiency

## Introduction

Although unknown to most, municipal wastewater is a source of renewable energy and contains more chemically bound energy (measured as chemical oxygen demand (COD)) than the electrical energy needed to treat it [1]. Chemically bound energy in wastewater mainly comes from human excrements, with carbon being the most relevant energy carrier. Nowadays, during wastewater treatment, microorganisms convert most carbon to CO<sub>2</sub> and biomass. More carbon should be recovered and transferred to digestion for biogas production in the future. Several methods for carbon recovery are available: screening, sieving, sedimentation, precipitation and flocculation, and flotation. Organic compounds can also be recovered by adsorption in a first stage of a two-stage activated sludge process. Pilot-plant scale experiments were carried out to find the sludge age at which most organic compounds are adsorbed. These investigations were undertaken within the project E-Klär, a government-funded joint research project that deals with the topic of energy efficient wastewater treatment plants of the future.

## Discussion

Advantages of a two-stage activated sludge system among others are: high load of first stage, separation of biocenosis of first and second stage and operation without primary clarifier. Beside this, in the first stage of a two-stage activated sludge process the COD of the influent is reduced significantly, see **Figure 1**.



**Figure 1:** COD elimination in the first stage of a two-stage activated sludge process depending on sludge age

Because there is only low respiration of COD most of the recovered organic compounds can be transferred to digestion. Not only particulate COD is removed but also dissolved COD due to adsorption.

## Conclusions / Outlook

While old, the two-stage activated sludge process may enjoy a comeback in times where energy efficiency is becoming essential. Organic compounds - dissolved and particulate - are transferred from wastewater into the sludge more efficiently than one stage processes can do. Sludge should be used for biogas production to increase energy efficiency of wastewater treatment plants. Biological wastewater treatment still needs organics for conventional nutrient removal, so carbon recovery is limited. Research is continuing to find autotrophic processes that do not need organic compounds for nutrient removal freeing carbon for biogas production.

*Acknowledgement: The authors would like to express their sincerest thanks to the Federal Ministry of Education and Research for funding the project E-Klär (promotion reference 02WER1319).*

## References:

- [1] Pinnekamp J, Kaleß M; Die energieeffiziente und ressourcenschonende Kläranlage der Zukunft; 15. Kölner Kanal- und Kläranlagenkolloquium; Aachener Schriften zur Stadtentwässerung, Band 18, 2014