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SEAWEED POTENTIAL FOR ANAEROBIC DIGESTION

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Over fertilization of waters results in extensive growth of algae causing disruptive changes to the ecosystems. Tackling eutrophication by recovery of nutrients from seaweed is the objective of the COASTAL Biogas project (Cluster On Anaerobic digestion, environmental Services and nuTrients removal). The project was founded to provide solutions based on anaerobic digestion of cast seaweed to coastal regions and to contribute to the transition to a circular bio-economy on the example of the south Baltic Sea region.

The amounts of biomass found in the different regions of Baltic Sea basin differ significantly depending on the winds and sea currents. The seaweed ends up on the coastal areas where it accumulates, dries up and decomposes producing bad smell and residues that decrease recreational value of the area. Theoretical annual amounts of seaweed in South Baltic countries (Lithuania, Poland, Germany, Denmark and Sweden) are estimated at over 1.8 miliion tonnes.

Taking into account the C:N ratio, seaweed found on the polish coast had slightly lower ratio (average of 17.8:1) than the optimal range for anaerobic digestion (20-30:1 - 30:1 C:N). Therefore they should be processed in co-fermentation with other resources, in this case cattle slurry. Addition of all the seaweed resulted in bio-methane yield increase compared to pure cattle slurry. The lowest increase was observed with *Enteromorpha compressa* (27.51%) and the highest one with *Potamogeton pectinatus* (151.91%). The influence of the others algae species was relatively on a similar level, *Zostera marina* (76.37%), mix of seaweed from Gdansk beach (76.64%) and *Enteromorpha plumosa* (81.57%).

Also the concentration of seaweed was found to have an impact on the process efficiency. An increase of bio-methane yield was observed when the algae concentration in the feedstock mixture was above 5%. Below 5% in the mixture, the yield was similar to pure cattle slurry, however the addition of 25% resulted in a sudden drop in bio-methane yield when compared to 20% (144.55 to 211.05 STP dm^3/kg VS respectively).

Seaweed seem to have a great potential as a feedstock in AD as they do not compete with terrestrial plants for agricultural land, but potential heavy metals content rises concerns in further digestate utilization. Among pure species collected in the Pomerania region the highest concentration of heavy metals was found in *Zostera marina*.

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INFLUENCE OF SEAWEED PRE-TREATMENT ON ANAEROBIC DIGESTION

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Anaerobic digestion is an environmental friendly technology allowed organic fertilizer production and energy recovery from cast seaweed. In order to obtain the best biogas yield the synergetic effect of co-digestion of cast seaweed and other biodegradable biomass should be used. For increasing safety process of anaerobic digestion and efficiency operation of the biogas plant pre-treatment of the cast seaweed is essential. Furthermore, different stages of pre-treatment as well as the combination of pre-treatment methods can increase the quality of the methane yield. The core function of different pre-treatments is to make organic matter more accessible to the microorganisms by breaking down the complex biopolymers, enhancing the bio-digestibility of the seaweed biomass through accessibility of microbial enzymes, and disrupting cell walls by bringing out the chemical substances from polymers into more available compounds. The presented results focuses on physical, thermal, chemical and hybrid marine biomass pre-treatment methods.

The first step of cast seaweed pre-treatment was removing sand by washing the marine biomass with fresh water in a tank equipped with a mechanical agitator rotated at a speed of 200 rpm. Washing was performed on raw biomass as well as mechanically disintegrated by a knife mill. The washing process was carried out at neutral pH as well as acidic (pH = 2). The degree of sand removal was determined on the basis of the mineral content in the biomass. The cast seaweed contained 39.1% of the mineral parts, and after washing by acidic water, the mineral content dropped to 4.5%. Sand separation efficiency can reach 89% and is most effective in acidic solutions and for not disintegrated seaweed.

The mechanical pre-treatment was based on grinding the seaweed in a laboratory knife mill at a rotational speed of 24,000 rpm. The time of grinding ranged from 15 to 180 seconds. The bio-methane yield in the co-digestion of mechanically disintegrated seaweed and cattle slurry (in ratio 1:3) increases slightly with the disintegration time and reaches the highest value for 120s of pre-treatment time. Further increasing the disintegration time doesn't case increase of bio-methane production.

Thermal treatment of cast seaweed carried out at the temperature of 95 and 160°C during 30, 60 and 120 minutes caused the highest increase in bio-methane production to 27%. Bio-methane yield achieved for **acid** pre-treatment did not influence strongly on the bio-methane yield.

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