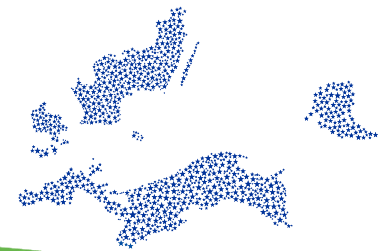




Cluster On Anaerobic digestion environmental Services and nutrients removal

Pre-treatment and Biogas Yield



Robert Aranowski
Final COASTAL Biogas Conference
9th December 2021

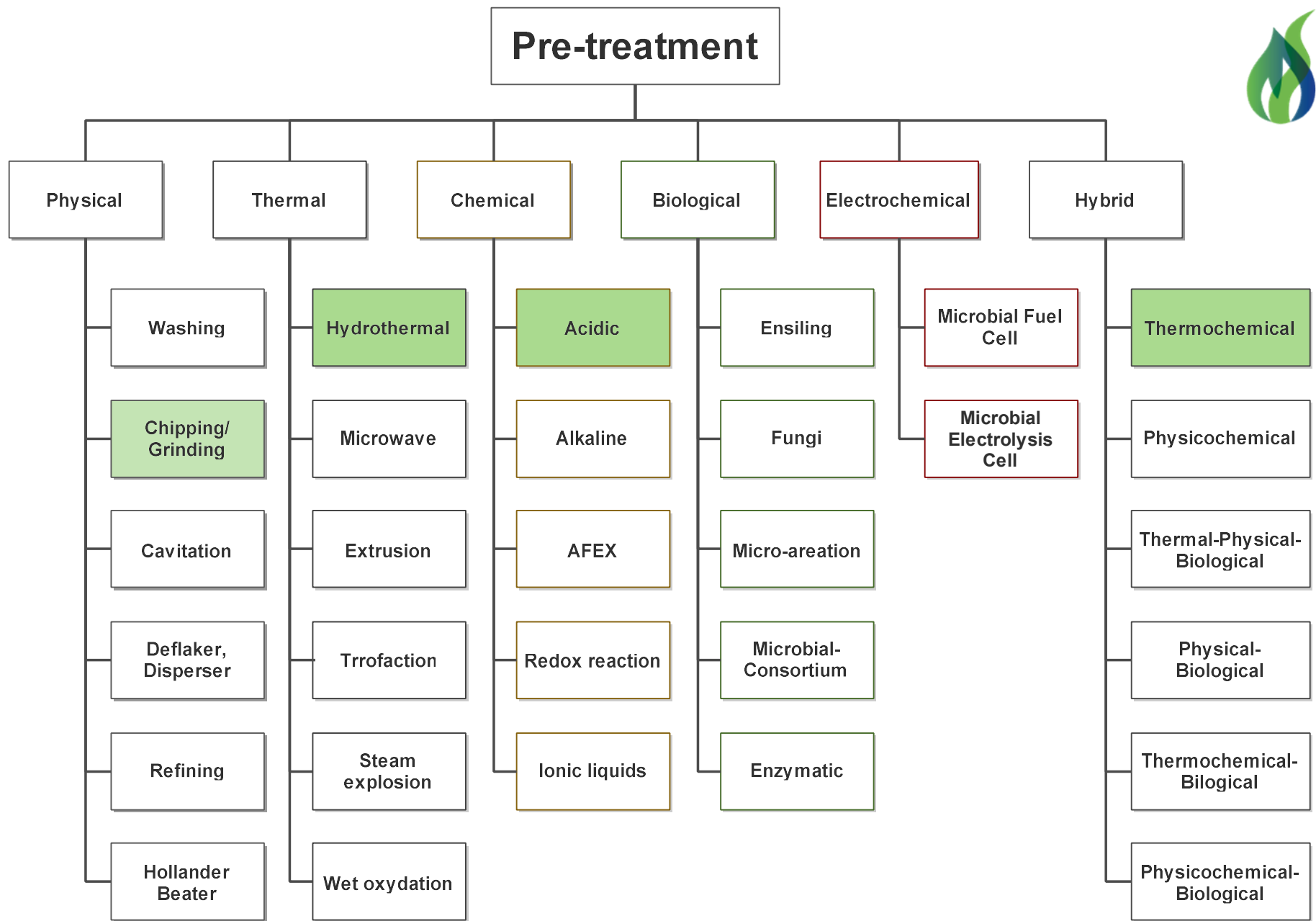
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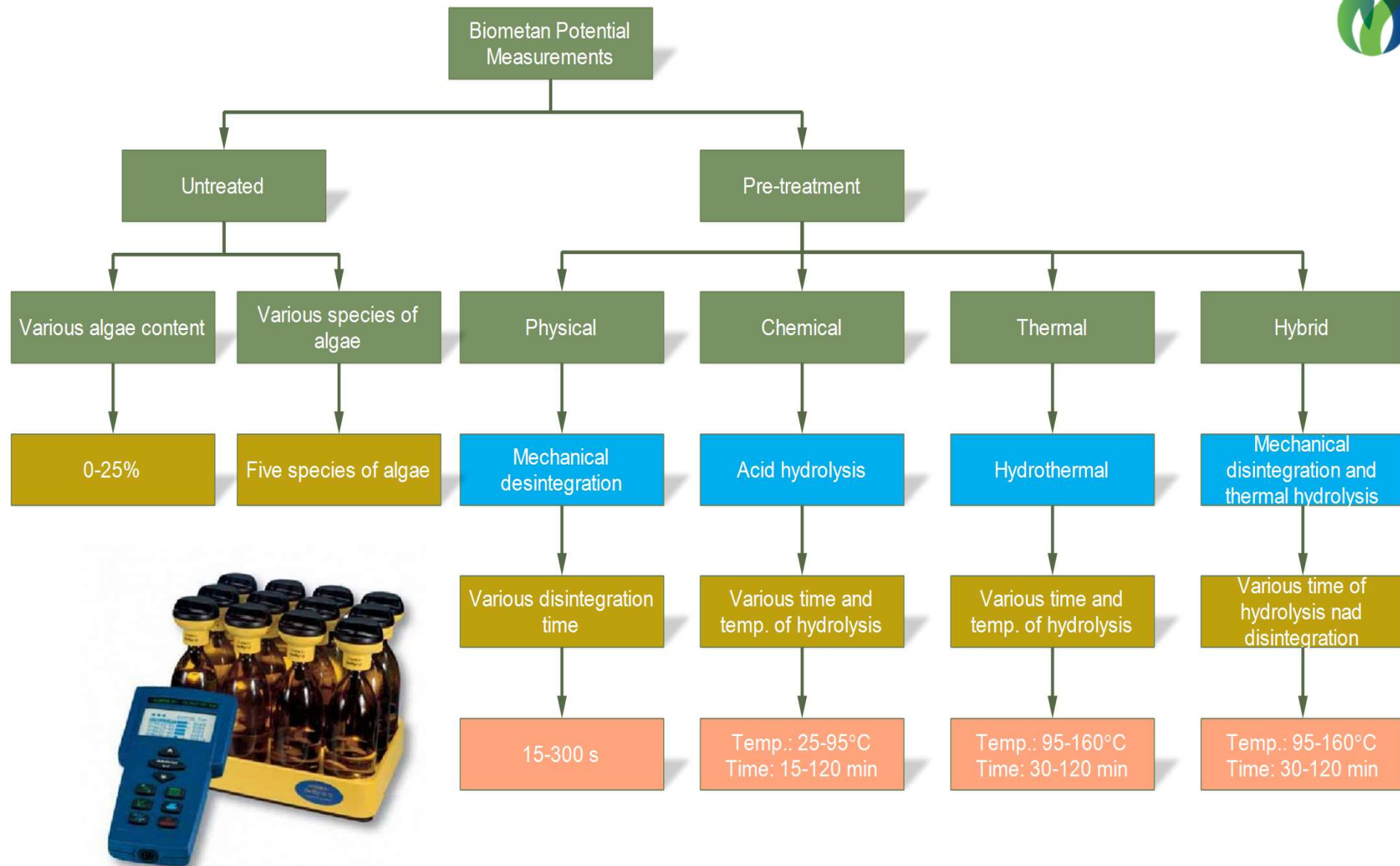
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Methodology of Laboratory Measurements of Algae Biogas Potential



The procedure of determining the biogas potential

- Amount of biomass mixture used for test was approximately 100 g
- The volume of OxiTop reactors was 1.1 dm³
- The temperature of incubation was 37°C.
- The reactors were mixed with magnetic stirrers at a rotation speed of about 180 min⁻¹.
- The total solids of the biomass mixture at the start of experiment was approximately 8%
- The experiments duration no less then 30-45 days



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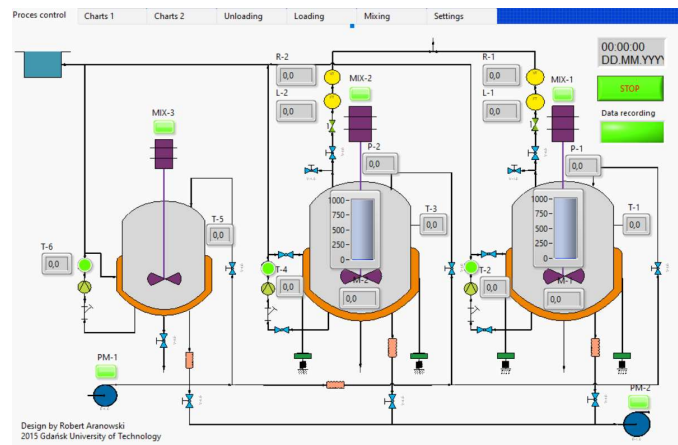


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Methodology of quasi-continuous digestion of algae biomass (10 L and 1000 L)



Control software of quasi-continuous laboratory digester



- Digester volume: 10 L and 1000 L
- Active digester volume: 7 L and 600 L
- HRT 21 days
- Digester load: 4 kg VS / (m³·d)
- Temperature: 37±0.1 °C
- Total solids: ~5.0%

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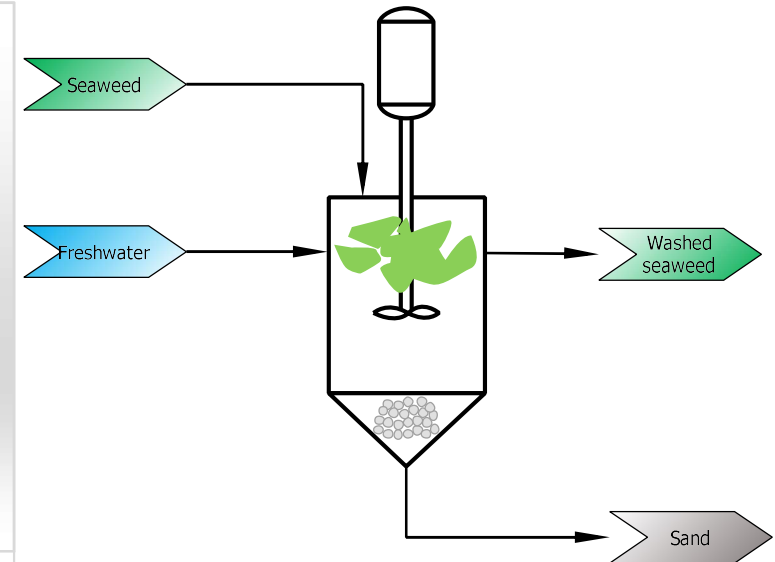
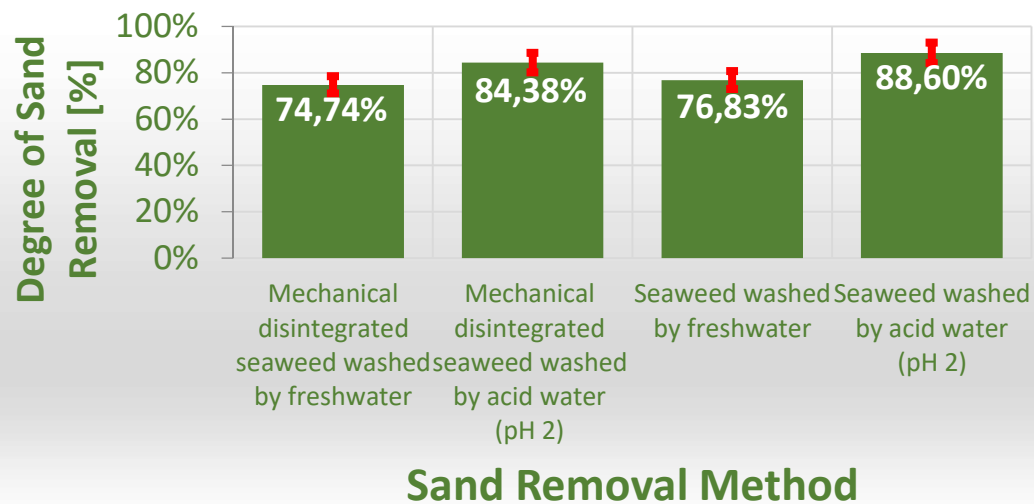
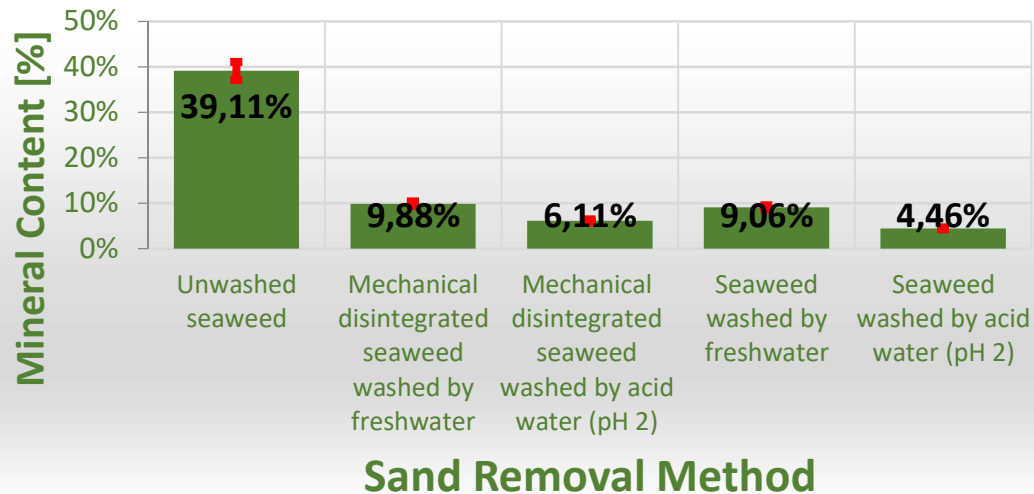


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Sand Removal



Sand removal was carried out in a tank equipped in agitator, which was rotated at a speed of 180 rpm



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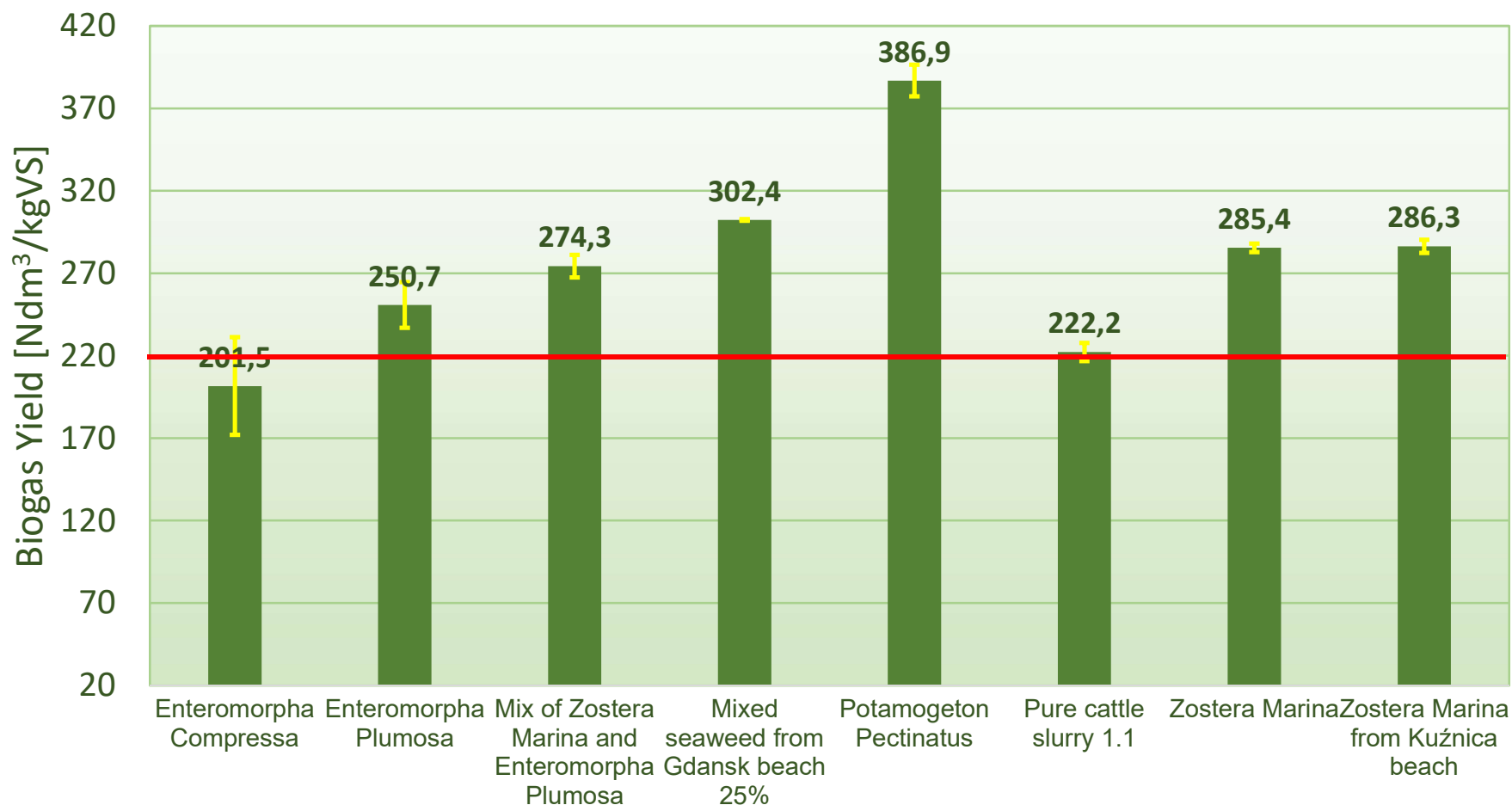


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Co-digestion of seaweed and cattle slurry



Marine biomass content in mixture – 25%
Time of digestion – 30 days

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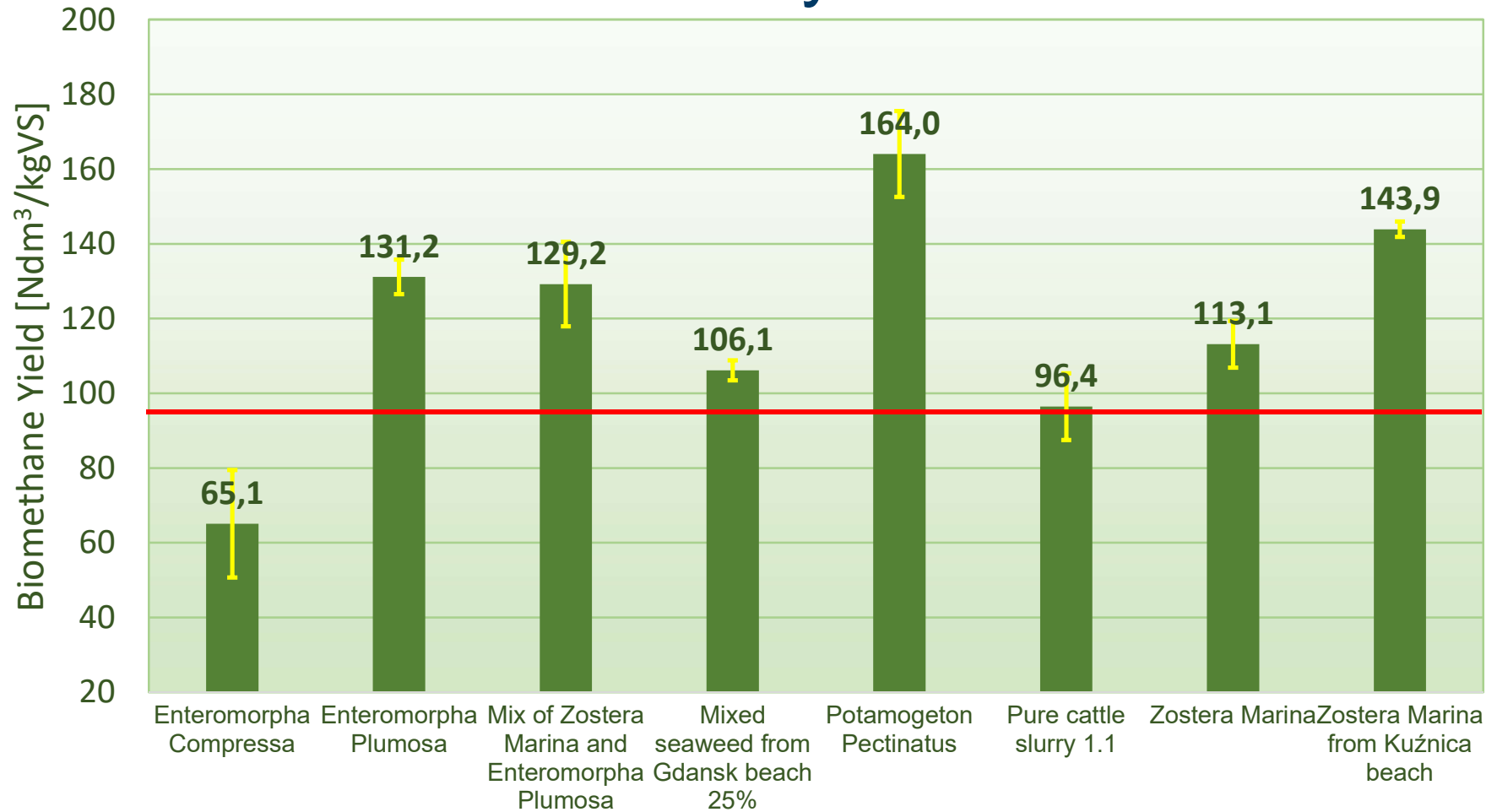


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Co-digestion of Seaweed and Cattle Slurry



Marine biomass content in mixture – 25%
Time of digestion – 30 days

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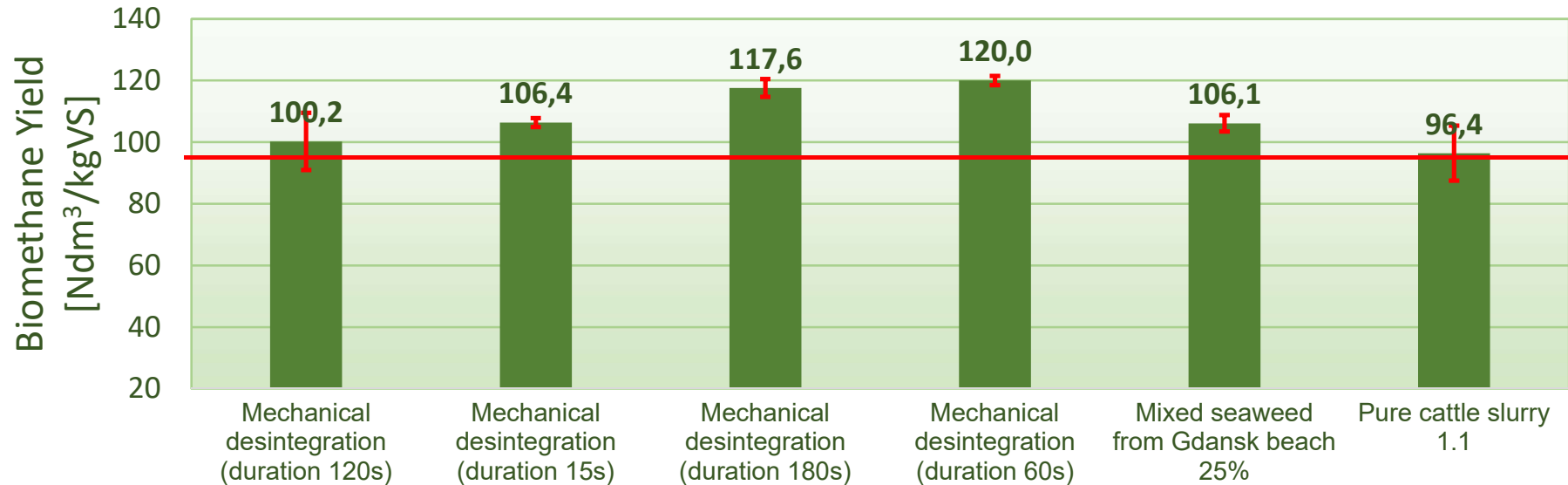


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Mechanical Pre-treatment



Biomass: mixture of algae from Gdansk beach
Equipment: laboratory grinder
Power: 1200 W
Rotary speed: 2 000 min⁻¹,
Screen: 200 mesh
Time of disintegration: 15-180 s.

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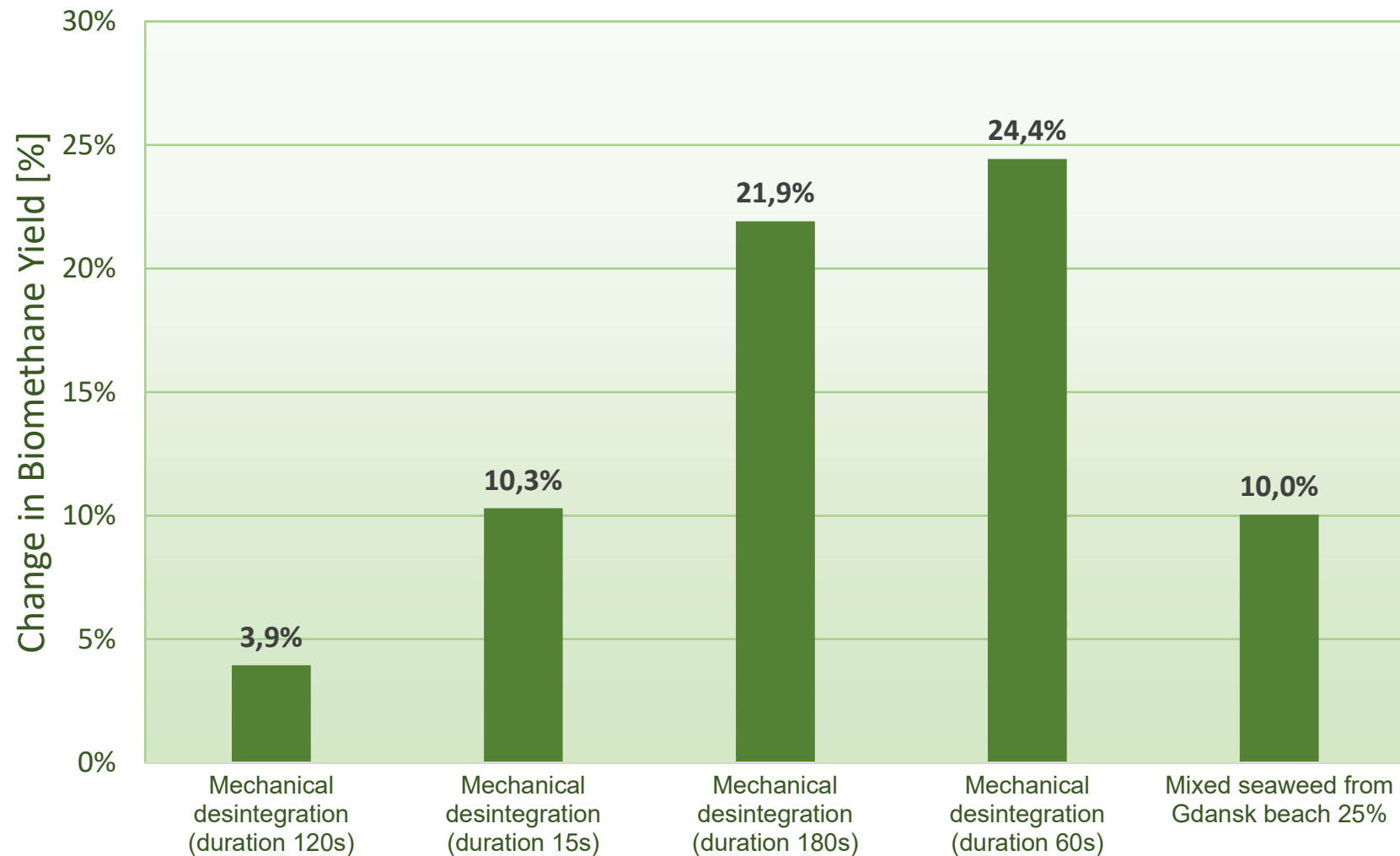


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Change in Biomethane Yield for Mechanical Pre-treatment in Comparison to Cattle Slurry



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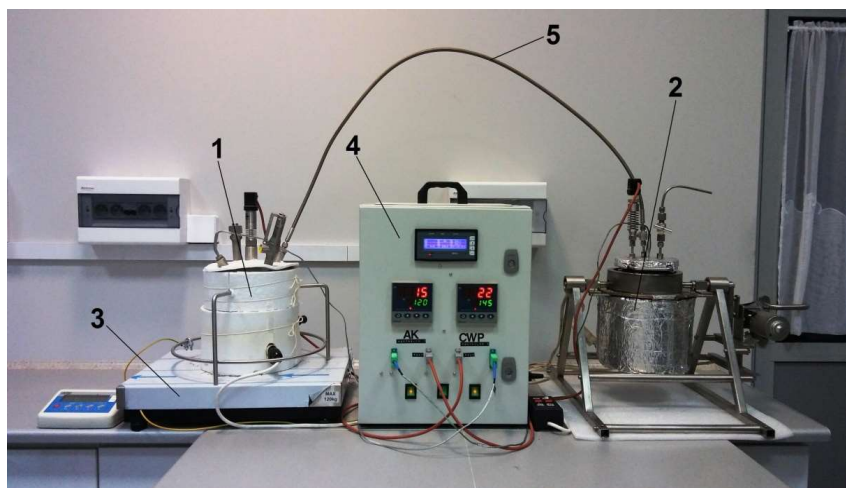
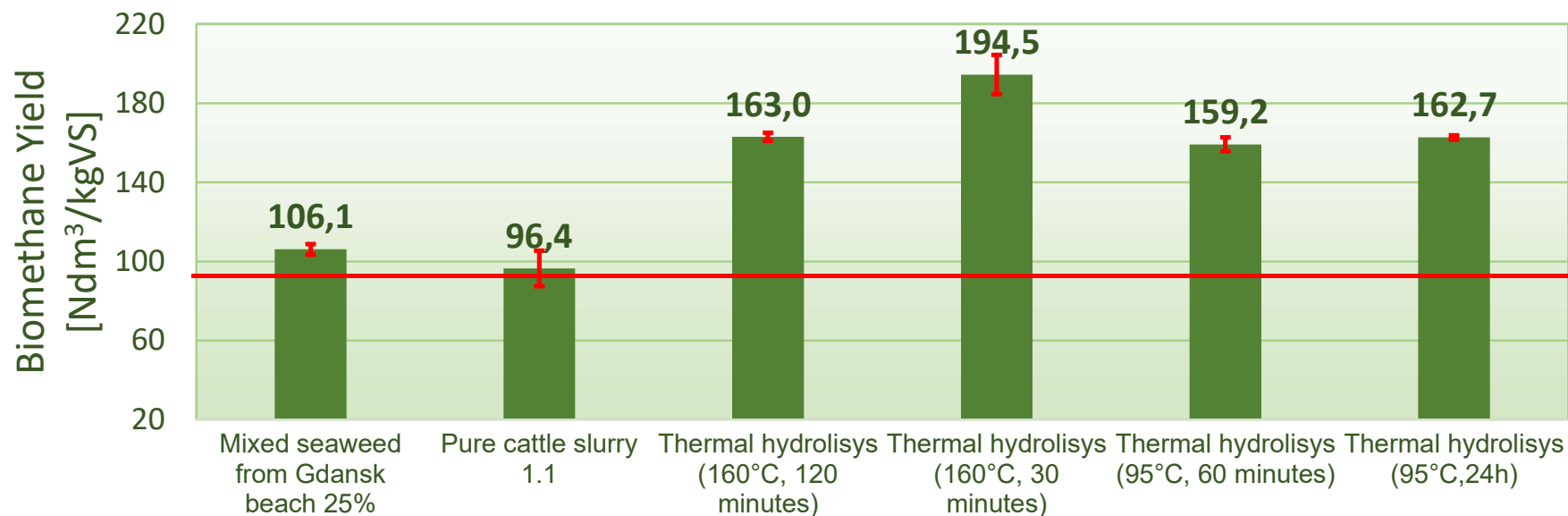


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Hydrothermal pre-treatment



System for thermal treatment of biomass (1) steam generator, (2) autoclave for hydrothermal lysis, (3) balance for measuring steam consumption, (4) control system; (5) steam connection.

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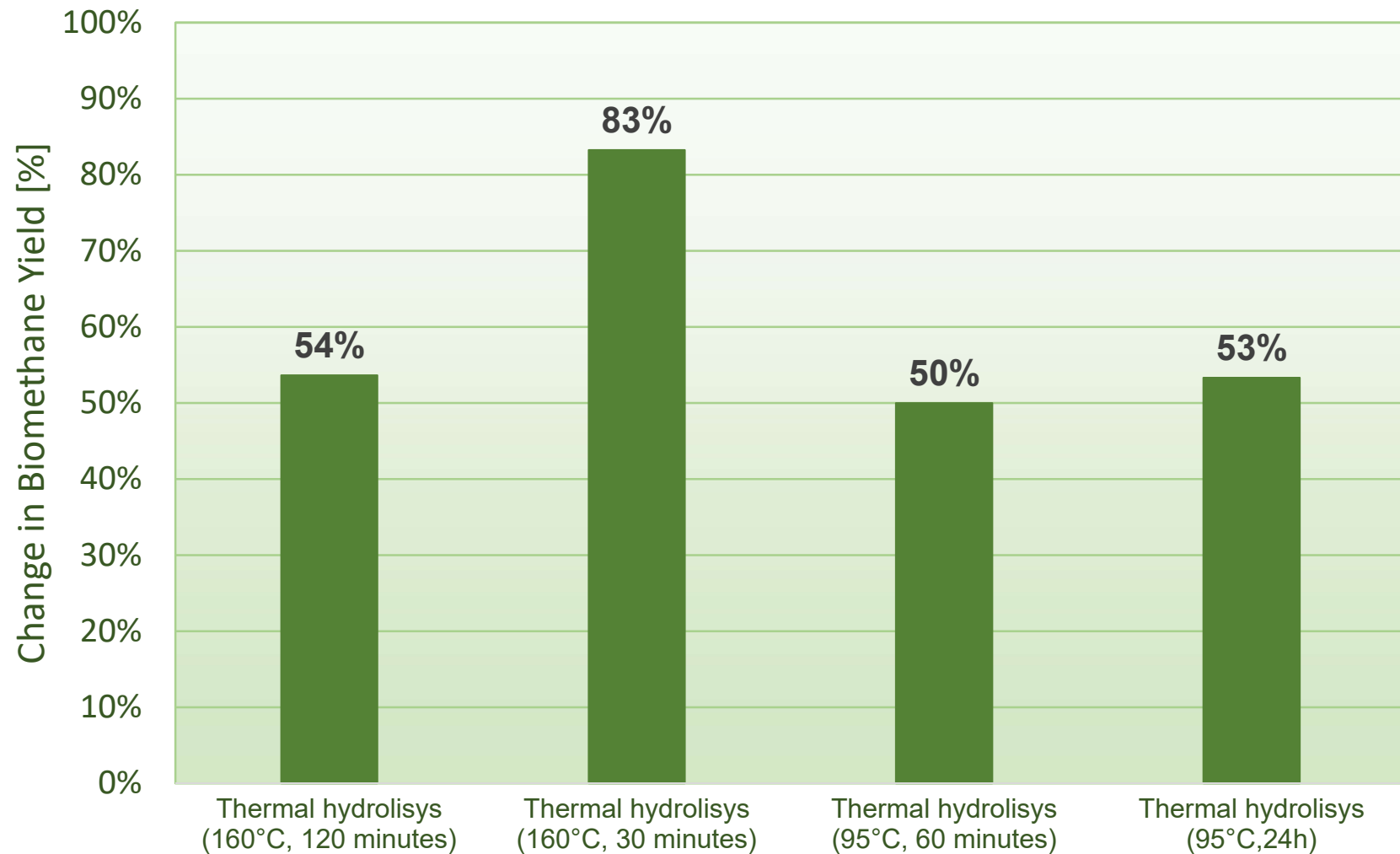


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Change in Biomethane Yield for Hydrothermal Pre-treatment in Comparison to Untreated Seaweed



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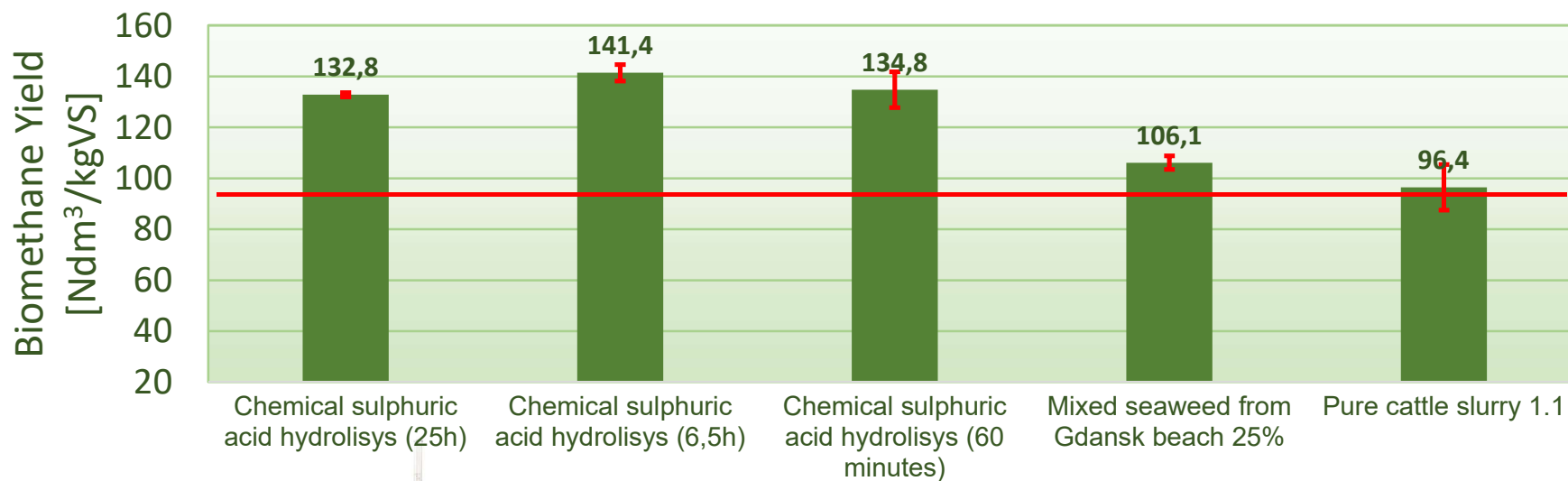


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Acid Pre-treatment



- In the acidic pre-treatment the marine biomass was treated by sulphuric acid solution of pH 2 for 1, 6, 5 and 25 hours respectively
- After certain time the solution was neutralised by adding sodium carbonate to the neutral pH level

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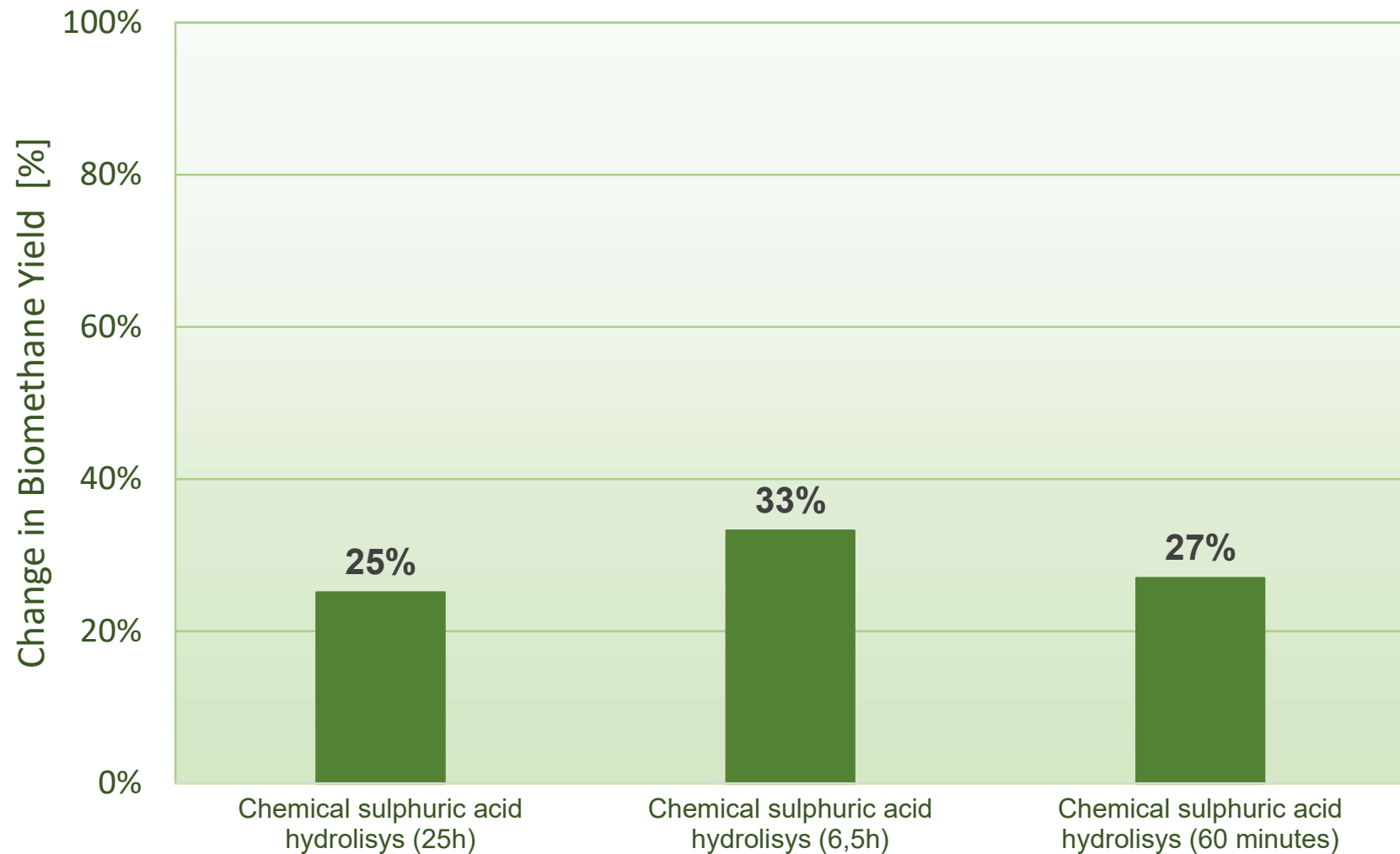


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Change in Biomethane Yield for Acid Pre-treatment in Comparison to Untreated Seaweed



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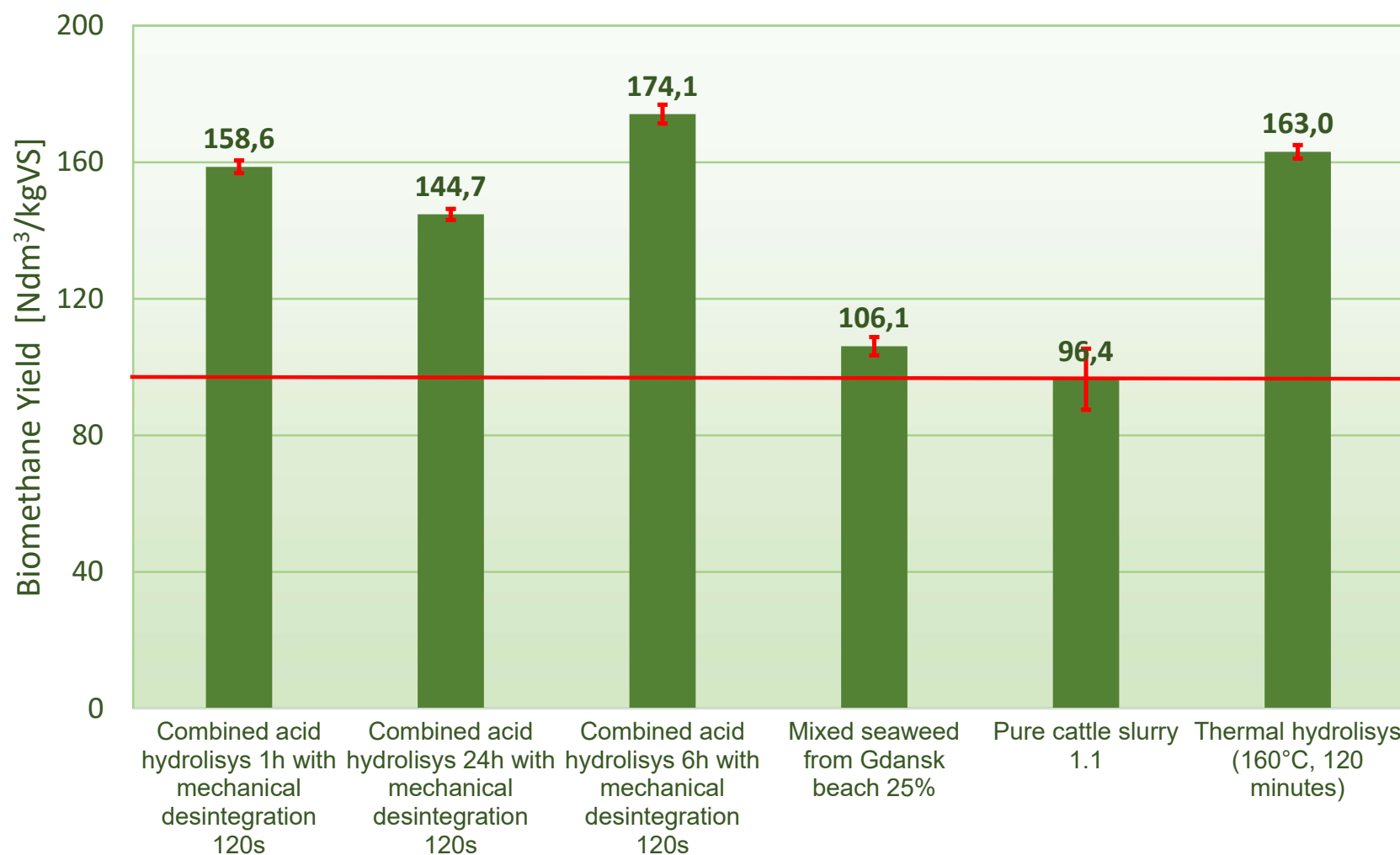


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Hybrid Method, Acid Hydrolysis and Mechanical Disintegration



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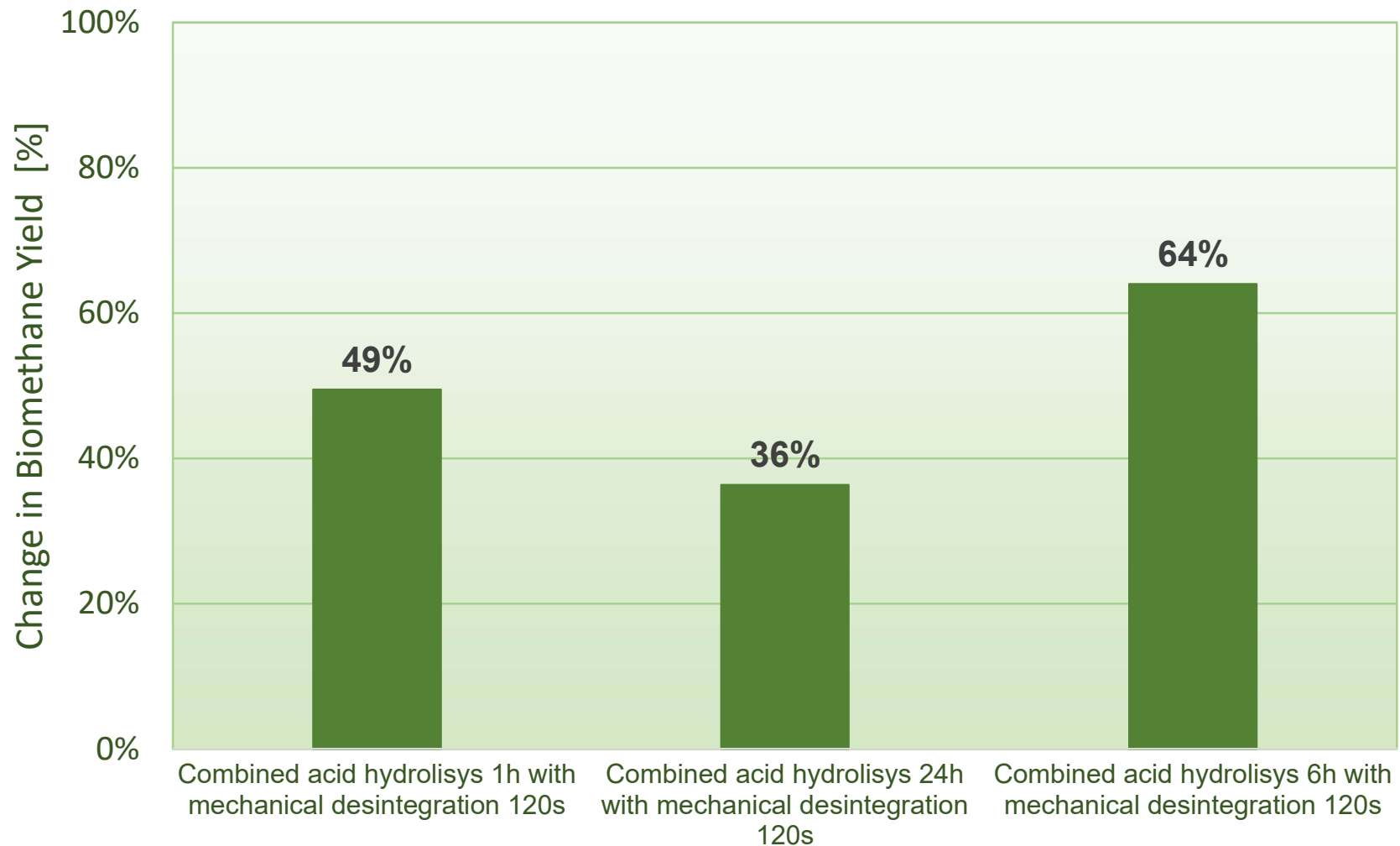


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Change in Biomethane Yield for Hybrid Method, Acid Hydrolysis and Mechanical Disintegration



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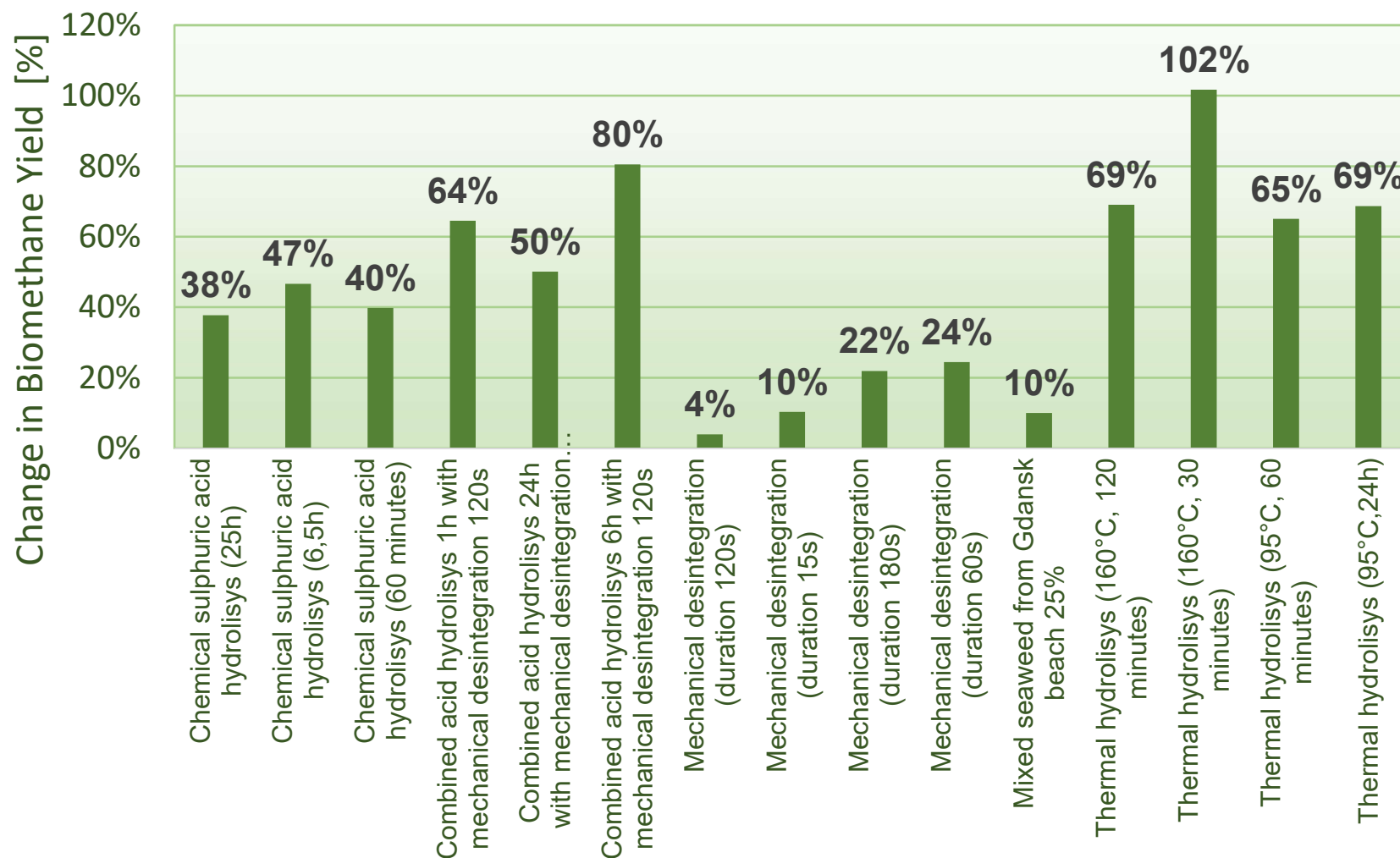


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Change in Biomethane Yield Compared to Untreated Seaweed



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Summary



Sand separation

- Sand separation is more effective in an acidic solution (pH 2)
- Mechanical grinding of marine biomass reduces the efficiency of sand separation in both acidic and neutral solutions

Pre-treatment

- Hydrothermal pre-treatment shows the highest biomethane yield increase compared to untreated seaweed and cattle slurry (50-83%).
- Mechanical pre-treatment results in the lowest increasing biogas and biomethane yield in the range from 4% to 24%.
- Biomethane yield for acid pre-treatment increase biomethane yield in comparison to untreated seaweed from 25% to 33%.
- Hybrid method give increase in biomethane yield from 36% to 64% with average value about 51%
- The results obtained in the quasi-continuous measurements of biogas potential are 20 to 40% higher than the values obtained in laboratory tests

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Thank you!

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