ULTRAWAVES BIOSONATOR FOR IMPROVEMENT OF BIOGAS PRODUCTION ON FARMLAND BIOGAS PLANTS (FBP)

Haren FBP, Germany – Case Study

I. Specifications of the plant

Plant size	• Power capacity 590 kW • 1 Main digester à 1,900 m3 • 1 Secondary digester à 3,300 m³ • 1 Storage tank à 3,600 m3
Substrates	• Maize silage, Pig slurry, Sugar beet, Grass silage, Corn-Cob-Mix, Straw, Horse manure

II. Objective of the high-power ultrasound installation

- Intensification of the anaerobic digestion process
- Reduction of the substrate input
- Increase in specific biogas yield/power capacity

III. Installation of the BIOSONATOR

- In July 2015 a BIOSONATOR (5 kW high-power ultrasound system) was installed.
- Sonication of a partial flow (1,2 m^3/h) recirculated from the secondary digester into the main digester in 24-hours-7-days-a-week-operation (see figure 1).

IV. Results of the high-power ultrasound installation

- The impact of the BIOSONATOR was already provable after one biomass retention time
- Provable reduction of the substrate input and costs even with decreasing quality of the main substrate (maize silage) and increasing power production: substrate savings of 8 % (fresh substrate) and cost reduction of about 10 % = 40.000 EUR per year (see figures 2 - 4).
  - The intermediate increase in daily feed of fresh biomass up to the former feed level in November and December is related to the fee of sugar beets with reduced quality.
  - The situation was discussed with the plant operator in December. Afterwards the process was corrected by stopping the feed of sugar beets without decrease in power production.
  - Consequently the economic balance of the BIOSONATOR installation could have been even more positive: The price for sugar beet is in the same range as the price for maize silage. But a ton of sugar beets has only 1/3 of the organic quality of maize. Therefore 3 t of sugar beets had to be fed in Haren for the same biogas production compared to 1 t of maize silage.

- Stabilization and increase in CHP-performance of about 1 % (5 kW absolute) and therefore additional income of about 5.200 € per year by the additional electricity production and a better exploitation of the net connection capacity (see figure 5).
    - From the beginning of November, CHP1 was operated in a pinched mode as the plants customers had a lower heat demand. This limitation weakens the economic result of the BIOSONATOR in the evaluation period
- Increase of the daily CHP run-time of about 2 h per day (figure 6).
- Increase of the biogas quality by an improved methane content of 1 % (see figure 7)
- Improved conversion of the organic dry matter in the main digester (+ 5%) and in the secondary digester (+ 13%) and thereby an overall increased degree of biomass degradation in the fermentation (see figure 8). Consequently less amount of organic dry matter remains in the digestate.
- Decrease of the biomass viscosity in the main digester (up to -63%) and in the secondary digester (-26%, see figures 9 and 10). Due to the decreased stirring time an evident decrease in energy consumption for biomass mixing was reached.

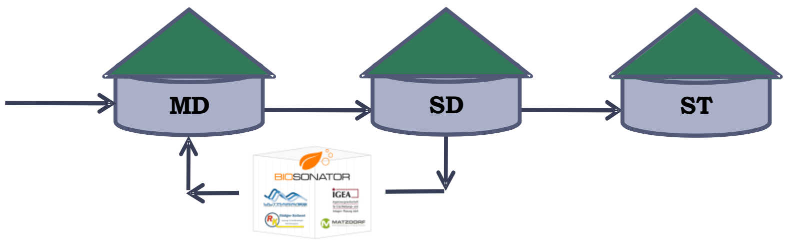

Figure 1: Layout of Haren FBP and integration of the BIOSONATOR.

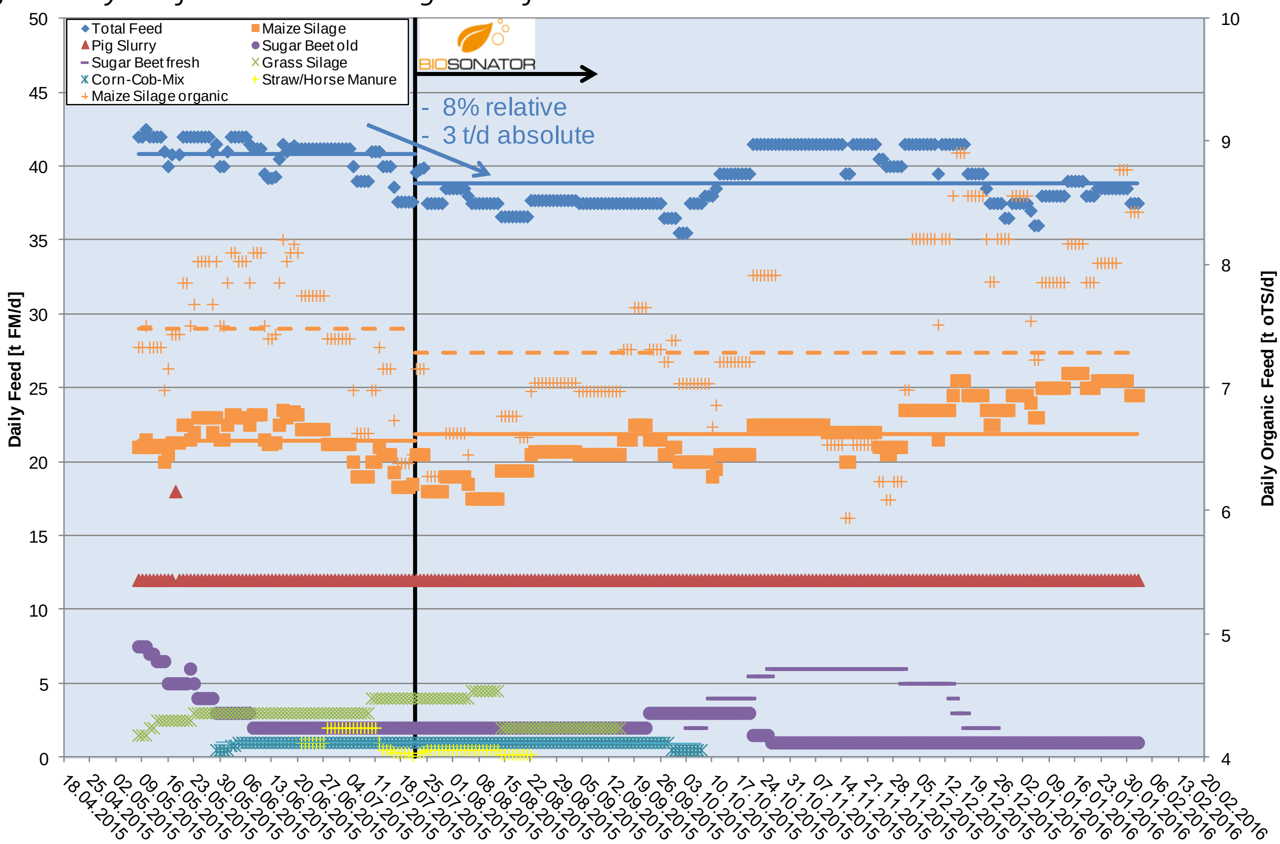

Figure 2: Reduction of the daily fresh biomass feed (vertical primary axis) and daily organic feed of the main substrate maize silage (vertical secondary axis) after start-up of the BIOSONATOR.

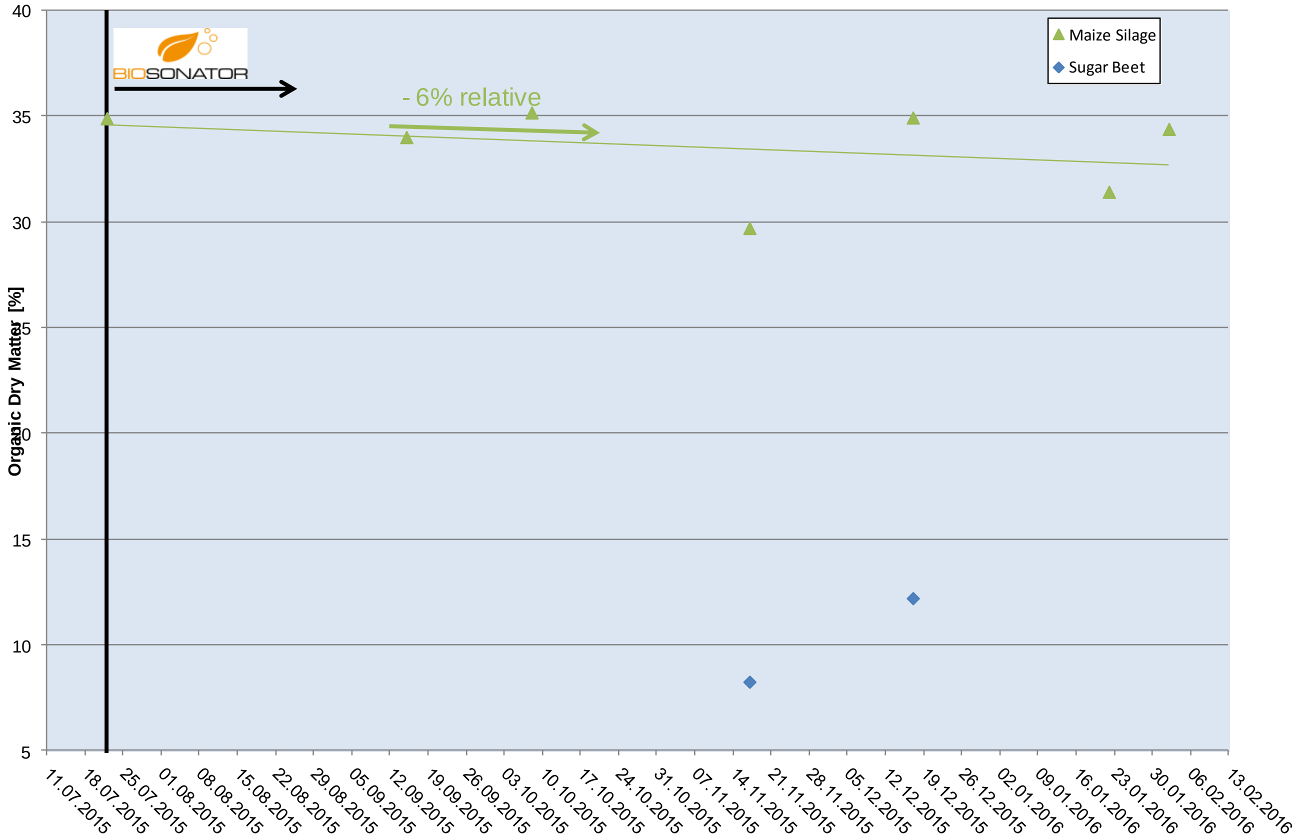

Figure 3: Reduction of the biomass quality (reduction of the organic dry matter) of the main substrate maize silage within the evaluation period and proof of the reduced sugar beet quality between November and December.

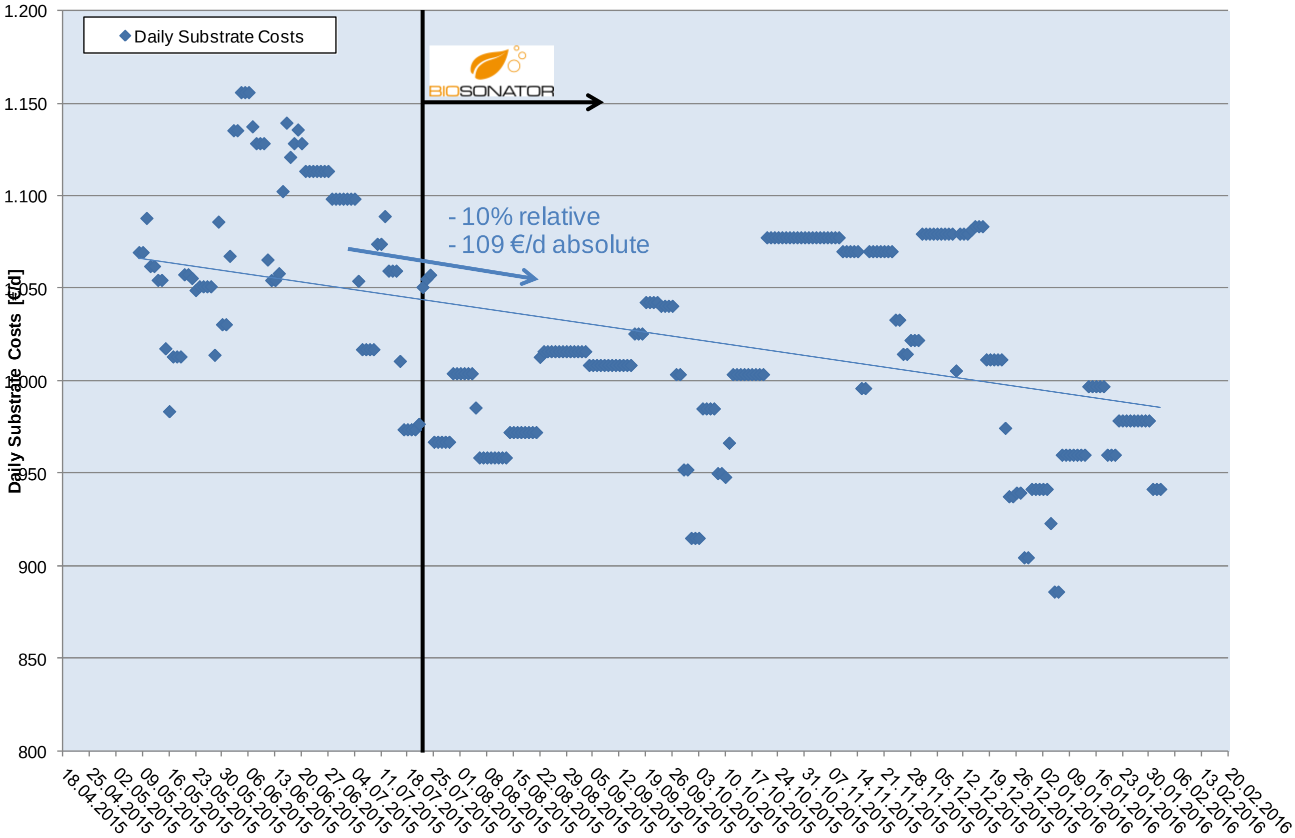

Figure 4: Reduction of the daily substrate costs after start-up of the BIOSONATOR.

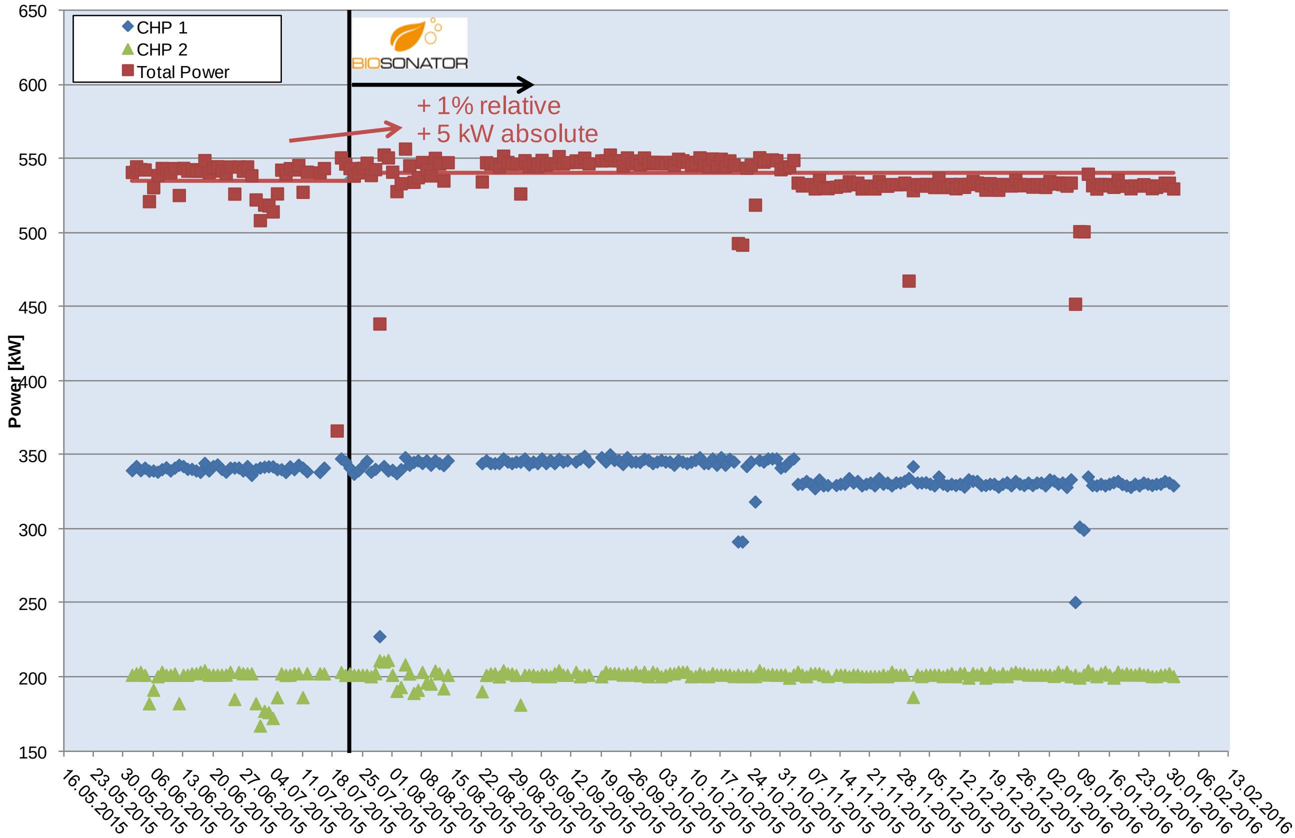

Figure 5: Increase in daily CHP power production after start-up of the BIOSONATOR. From the beginning of November, CHP1 was operated in a pinched mode due to the reduced heat demand from the plants customers.

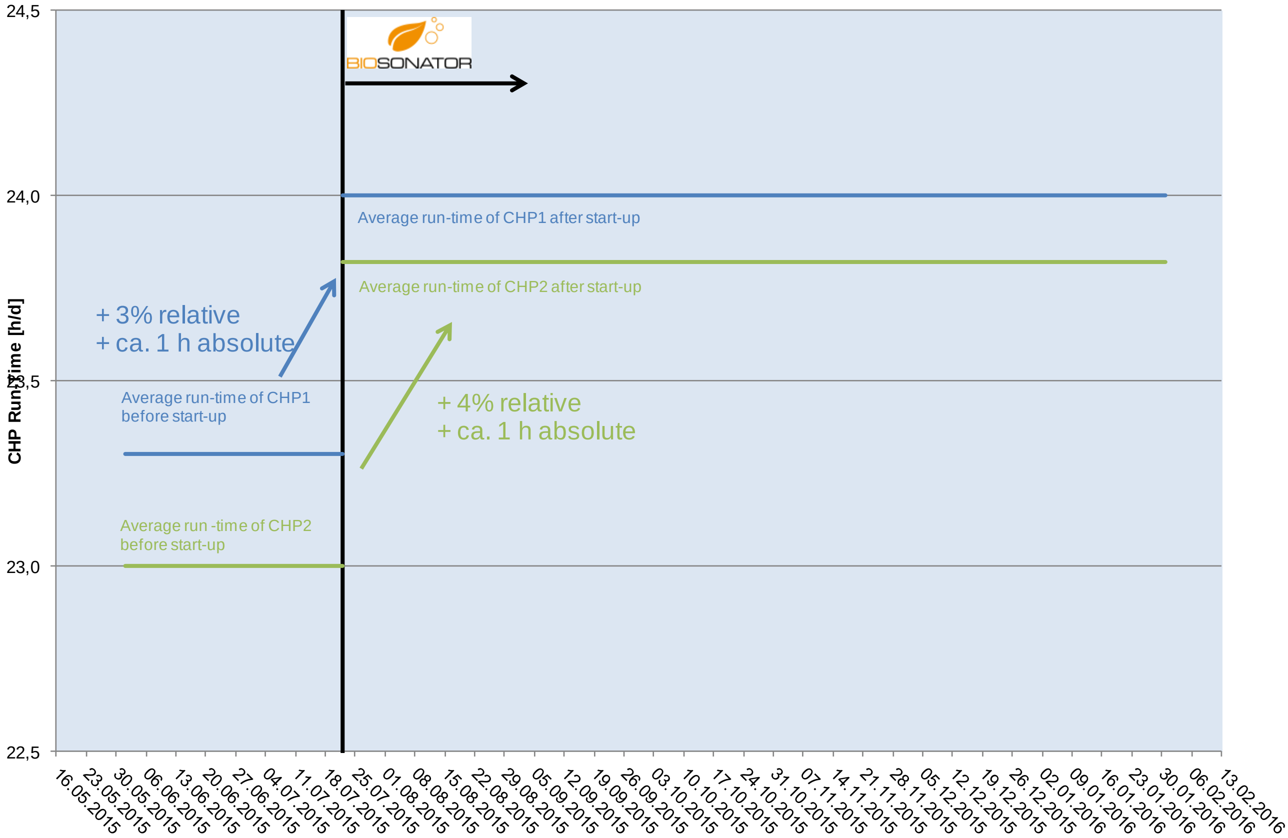

Figure 6: Increase in daily CHP run-time after start-up of the BIOSONATOR.

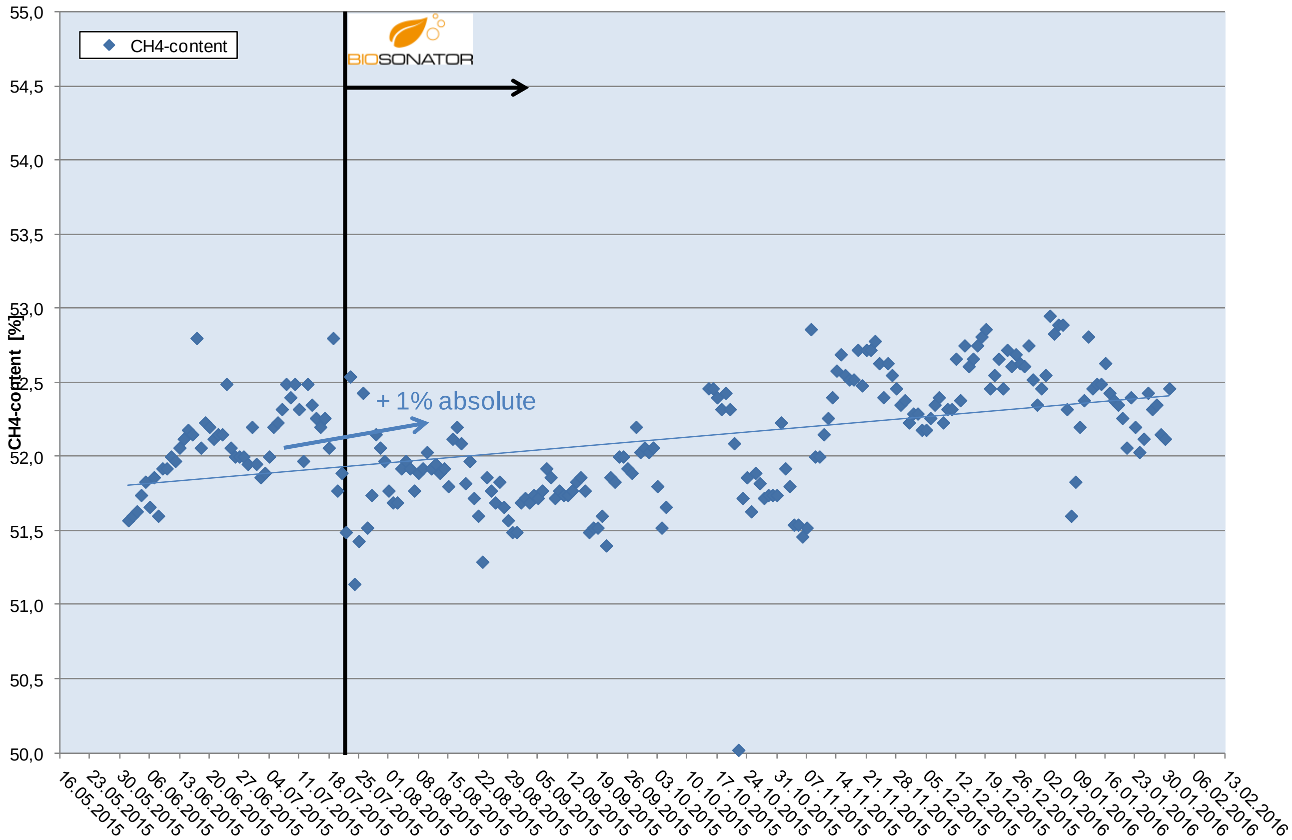

Figure 7: Improved methane content and therefore an increase in biogas quality after start-up of the BIOSONATOR.

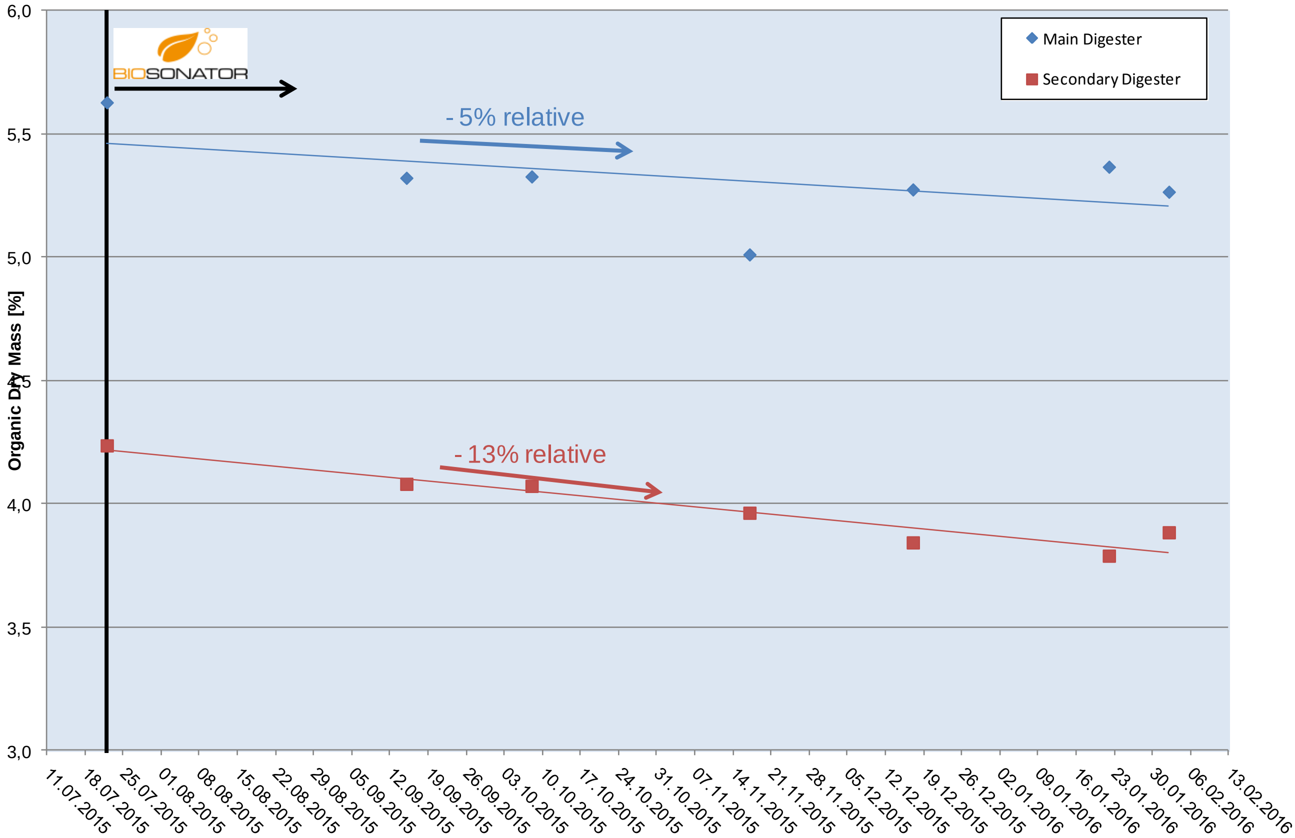

Figure 8: Improved conversion of the organic dry matter in the main digester and in the secondary digester after start-up of the BIOSONATOR.

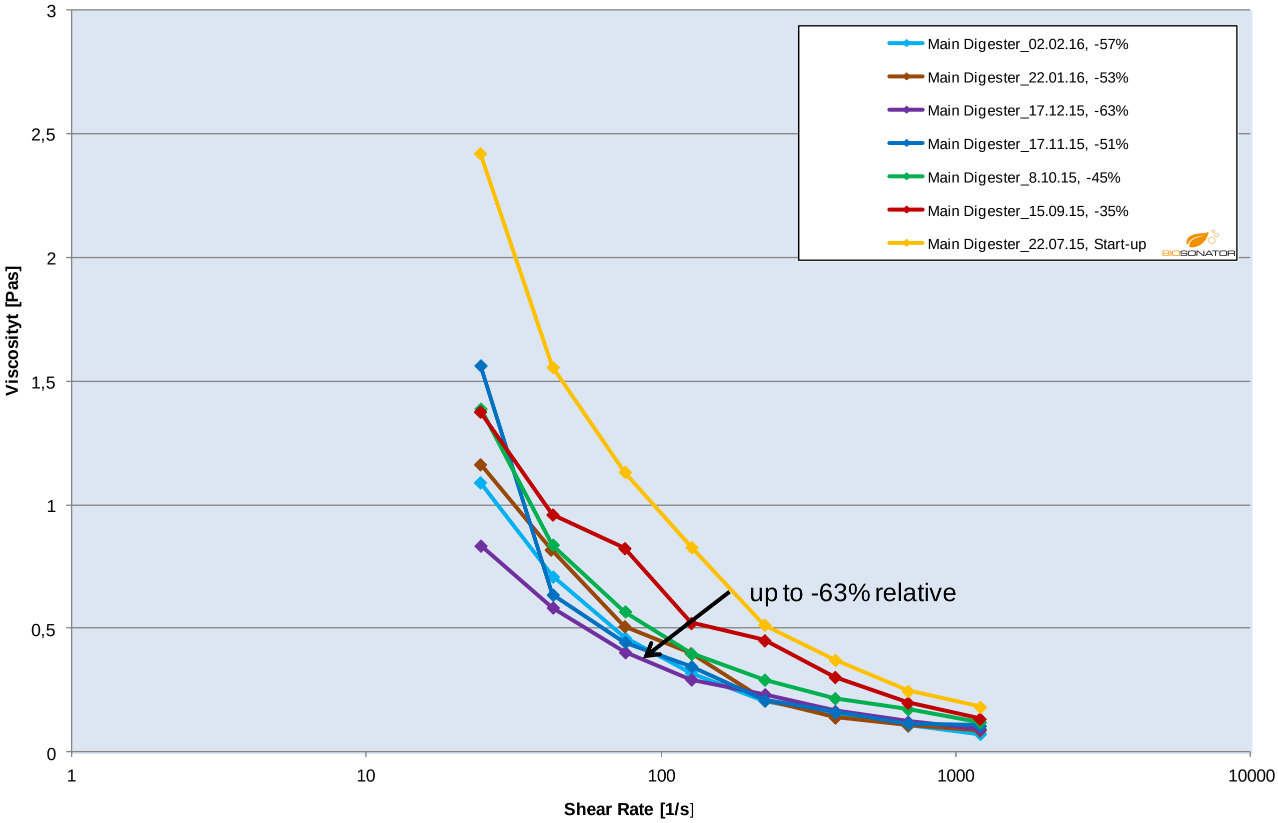

Figure 9: Reduction of the biomass viscosity in the main digester after start-up of the BIOSONATOR

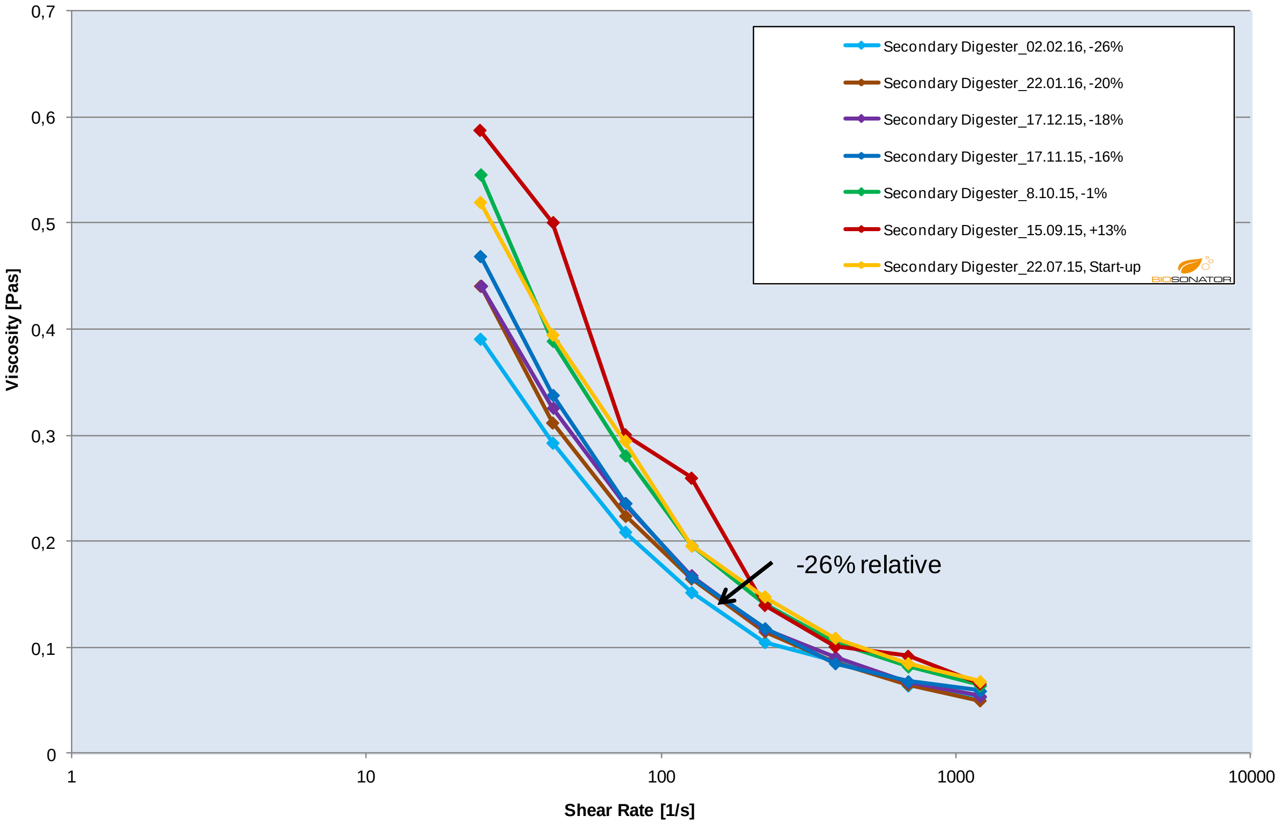

Figure 10: Reduction of the biomass viscosity in the secondary digester after start-up of the BIOSONATOR

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