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Report 7: progress of the engineering work and status of operation

1. STATUS OF THE OVERALL PROJECT AT SKOGN

Biokraft started the operation with filling the multifuel bioreactors with bacterial culture (inoculum) and raw material at the end of June 2018.

The Biogas production had a stable growth and already the 1st of September 2018 we started the first production of liquified and upgraded biogas.

The official opening of the plant with the Norwegian Prime minister was the 2nd of September 2018.

During the first year of operation the production of biogas using feedstock from Norwegian fish farming, agricultural waste and biosludge (waste activated sludge) from the pulp and paper industry (Norske Skog Skogn) has been quite stable. However, there have been several challenges in the downstream processes including dewatering and reject water evaporation. Furthermore, in a few occasions, the adoption of new substrate required a sort of “start-up approach” to secure stable process parameters.

The upgrading and liquefaction of the raw gas have periodically been quite challenging. There have been need of several repair works with stop of upgrade and liquefaction production. The first year of operation had a total production of ca 80% of budget and capacity. Today, however, most of challenged has been undertaken we are now stabilizing at a production of more than 90% of budget and capacity.

Because of the delays in construction and commissioning, Biokraft had to prioritize the completion of the plant, so that the main biogas production line – the multifuel production – was completed before the closing work on the ECSB reactor and production line.

The start-up phase for the ECSB production with a limited use of wastewater from the pulp and paper mill, started in late fall 2018. Operation were very unstable due to a number of reasons (e.g. high TSS, mechanical failures, pick of sCOD). Therefore, Biokraft, Norske Skog and the supplier decided to stop the further ramp-up in the winter of 2018/2019 to identify and remedy the key problems.

After different repairing work and a series of analysing of the wastewater, the granular sludge and the bio-chemical conditions (nutrients availability), operation started again. A slow but stable new ramp-up phase of the ECSB started in spring 2019. Since this new start, the equipment and the bio-chemical conditions seems to be greatly improved, and with some minor improvement and fine tuning of production conditions, we are now at a quite stable loading and production.

2. TAKE OVER TEST

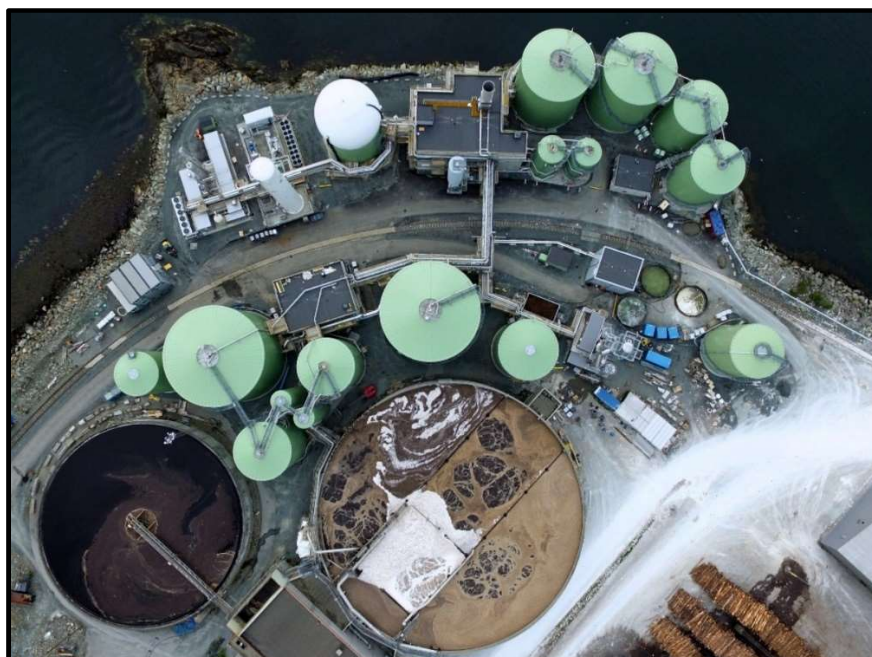
Take Over test for all parts of the plant have now been completed and approved by Biokraft.

The different Take-Over certificates by date:

- Multifuel (CSTRs) 17.01.2019
- Upgrade 02.05.2019
- Liquefaction 02.05.2019
- ECSB 29.10.2019

Performance/Acceptance test has been completed and approved for the Multifuel. Performance/Acceptance tests for the rest of the plant have been partially completed or planned within a short time, but the results for this are fully processed.

- The Performance test for ECSB is completed, but the results are still under revision.
- The Performance test for Upgrade is completed, but the results are still under revision.
- Performance test for Liquefaction is not completed yet.



Picture showing interface between Biokrafts plant and NSS wastewater Treatment Plant.

3. PRODUCTION OF BIOGAS

The status of the production of biogas (multifuel + ECSB) is the following:

LBG produced	November	December	January	February	March	April	May	June	July	August	September	October
Nm ³ -CH ₄	480 055	591 666	669 194	750 527	748 250	748 250	840 611	830 444	885 492	880 305	567 757	779 472

The total LBG production has the last week stabilized at ca 1400 Nm³/h which is equivalent to 980 000 Nm³ LBG a month.

(...)

Confidential information. Please contact the project manager Dr Francesco Ometto for further information.

The production in the ECSB reactor has the last weeks stabilized at ca 180 Nm³/h which equals to ca 1,5 mill Nm³/year. Periodically the production is more than 200 Nm³/h, and the variations is probably both dependent on the quality of the wastewater but also the need of continuous monitoring of operation, where all operating parameters must be adjusted according to the quality of wastewater and the conditions in biology.

The Norske Skog Saubrugs (sister plant in Halden, Norway) have a similar ECSB plant to produce biogas out of the wastewater. The operation at Biokrafts ECSB unit has achieved significantly better stability and production than Saubrugs. This is probably because of good work but also that the biological interaction with the ECSB receiving reject water from the Multifuel plant is an important success factor.



Picture showing Biokrafts plant in front and NSS papermill in behind.

4. STATUS OF THE EFFISLUDGE ACTION INCLUDED IN THE BOKRAFT PROJECT

All equipment needed for the implementation of the EffiSludge principles at Biokraft and Norske Skog Skogn is now installed and in operation/ready for operation.

The EffiSludge project team has made a significant contribution in connection with analyses of operating conditions in both NSS treatment plants, but indirectly also in connection with the start-up of the ECSB reactor, since the impact of biogas production on conditions in the NSS treatment plant is an important part of the project.

The successful status of the ECSB production is therefore partly because of the resources and competence of the EffiSludge team.

The situation with stabilized biogas production in the ECSB digester are now under continuous measurement, and the EffiSludge team are now preparing for the next phase of implementing the EffiSludge principles.

5. EXPECTED PROGRESS UNTIL THE NEXT REPORT

Upon the next report, we expect to have implemented the EffiSludge principles in the NSS treatment plant, and are measuring the effect on all measurable conditions relevant to the EffiSludge project over 2020.