

Annex A1-2

Summary report on methods and evaluation tools



Subject	Project acronym / Ref. No.	Date
<i>Deliverable under Action A.1</i>	Etanolix 2.0 for LIFE+ / LIFE12 ENV/SE/000529	21/08/2015
Issued by	Company / Department	
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Summary report on methods and evaluation tools

Management tools

The project plan has been an important document for everybody in the St1 organization involved in the project. Starting from higher management and the Steering Group members (PMG) and thereafter distributed out in the organization to all personnel to raise awareness of expectations, responsibilities and deadlines to deliver results on time and within budget.

Normally, when the refinery works on projects the focus is on technical solutions, economics and time. Project management from a normal industry- technical perspective is something the refinery is experienced and successful in. Procedures are implemented since way back and used as common practice within the organization. Having the possibility to work with a granted LIFE+ projects is increasing the dimensions compared to a traditional refinery project in many ways since e.g. Communication, Dissemination, Networking and Socio-economic aspects are included as part of the project. This is increasing the normal project scope and will help focusing on other important deliveries and results; meaning different methodologies and evaluation factors are needed to be applied. This is in one way a challenging task, but at the same time an opportunity for development and improvement to “think out of the box”.

The methods and tools for e.g. time reporting for personnel and the cost control for the project has administrative been add on tools to the refinery’s existing methods that are obliged to follow as well.

Methods employed

One important part in the project has been to develop evaluation methods of the technical production processes to ensure the plant will work according to refinery integration and management quality systems.

- To be able to operate the plant the process units have to be monitored continuously (via DCS and ABB).



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- The product and bi-product, ethanol and stillage, has to be controlled to fulfill the specifications defined.
- The environmental aspects for the pilot plant have to be monitored, some of the parameters also to be analyzed by external laboratory to comply with authority requirements. Feed-stock volume of received renewables to be processed is to be measured and documented. Methods for monitoring and evaluation has been defined and documented in Control frameworks or instructions in the refinery.

Sustainability criteria, Greenhouse gas calculations and Life cycle analysis are methods still to be developed and executed. Back-ground data required to enable the evaluation of these parameters are already defined and data gathering, for parameters already able to be measured, has already started.

Process control, unit efficiency and KPIs:

The methods and evaluation tools for the daily control of the pilot plants operation parameters have been selected by the refinery Technical Working Group together with the St1 Biofuels organization.

- Responsible for the process operational activities is the Operations Manager for the refinery, Johan Dahlberg. Action owner for the daily evaluation regarding process parameters are the Process Engineer Lars Olausson. He is analyzing the performance data from process trends and laboratory analysis. The data collecting and reporting on throughputs, energy, water, unit efficiency and utility use is also done by the Process Engineer according to procedures developed.
- Responsible for the daily practical operations of the receiving station and the integration is the refinery's Maintenance manager Oskar Bengtsson, who has two dedicated persons managing the operation of the receiving feed-stock material, water treatment, on-line instrument controls, basic process measurements and housekeeping etc.

Raw material as feed-stock, ethanol, stillage and waste:

- Responsible for the daily supply, distribution and logistics processes is Roger Sjöström, hired explicitly for the project. Methods and evaluations for these tasks to be performed are developed and implemented. Still to be fully incorporated in the refinery documentation framework.
- The product quality acceptance, before pumping the ethanol, into refinery tank farm system and the actual pump ordering is done by the refinery Supply department. A new procedure (RDP 8.07) incorporated and implemented in refinery quality system.



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Environmental monitoring:

- Responsible to fulfill the environmental criteria is the Health-, Safety-, and Security Manager Eva Bergström, who also is responsible to report the results to the local authorities. This is in accordance with normal refinery procedures and with Swedish legislation. Control framework is agreed between St1 Refinery AB and Länsstyrelsen I Västra Götaland, dated on 07/07/2015. The Etanolix 2.0 Control framework, and thereby the key performance indicators to evaluated the pilot plant on environmental efficiency, is an official document.

Laboratory Analysis:

Laboratory measurements in line with well-defined and repetitive methods are essential to enable any pilot plant operation. Quality control of products, test runs and demonstration are all depending on correct results from sampling and analysis. To have methods and evaluation fit for purpose and being able to draw conclusions from trustful data is essential for a production unit as this. The most of the analysis will be performed within the refinery's internal Laboratory department. See below instructions for parameters to be analyzed and the frequency.

Point of analyzis	Analyzis
Hydrolysis to fermentation SP-12002 after mash-cooler E-7802 Temp 68°C Once a day 08:00	pH-value Dry solids m/m% Compare pH-result with online-measuring 78QI1 (hydrolysis)
Fermentation SP-13001 Fermentation vessel V-7806 SP-13001 Fermentation vessel V-7806 SP-13001 Fermentation vessel V-7806 Once a day 08:00	pH-value Dry solids m/m% Iodine starch Troubleshooting: sugar (glucose, maltose, malotriose), glycerol, ethanol, lactic acid and acidic acid with HPLC
Animal Feed/Stillage SP-17003 When at least half-full tank or during loading of truck.	pH-value Dry solids m/m% Salmonella samples 2/week Specific analysis/limits to be defined due to customer demand or to HACCP (Hazard Analysis and Critical Control Points).



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	Sample to be saved for 2 month.
Process sewer water (online measuring) Position 78FIC24 Flödesmätare Position 78QI4 pH-mätare Position 78TIC30 temperaturmätning SP-22001 Once a day 08:00 Once a week	Demand from Environment authorities and agreement with Refinery. pH Suspended solids m/m% Chlorides m/m% BOD7 COD Total nitrogen Total phosphorus conductivity

Distillation and dehydration analysis schedule

Point of analysis	Analysis	Notes	Spec
After warm retentate cooler E-7815 SP-15002 Twice a day 08:00 and 14:00	pHe Conductivity Alcoholic strength m/m/density Water S SO4 Total acidity	If low conductivity must pHe be 6,5- 9,0. GC for test of feedstock or with trouble shooting	6,5-9,0 < 2,5uS/cm > 99,7 < 0,3 m/m% < 10 mg/kg < 4 mg/kg < 0,007 m/m%
Ethanol from distillation SP-15003 Twice a day 08:00 and 14:00	pHe Alcoholic strength m/m%/density	Compare density with online- measuring 78DI32.	6,5-9,0
SP-15004 Twice a day 08:00 and 14:00	pHe Color Alcoholic strength m/m/density	130°C	Like "tea"



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Permeate 1 SP 15005 Once a day 08:00	pHe Alcoholic strength m/m/density	135°C	< 30 m/m%
SP-15006 Once a day 08:00	pHe Alcoholic strength m/m/density		< 20 m/m%
Product tank T-7801 before release to refinery SP-16001	pHe Alcoholic strength m/m/density Water content conductivity	GC if alcoholic strength less than 99,7 m/m% or if there have been big changes in feedstock.	6,5-9,0 > 99,7 m/m% < 0,3 m/m% < 2,5uS/cm

Product specification from distillation

Analysis	Unit	Limit	Method
Color		Clear and without color	EN 15769
Total Acidity (as acidic acid)	m/m%	< 0,007	EN 15491
Ethanol content	m/m%	> 90,0	EN 15721
More saturated carbons (C3-C5)	m/m%	< 2,0	EN 15721
Methanol	m/m%	< 1,0	EN 15721
pHe		6,0-9,0	ASTM D 6423
Unorganic clorides	mg/kg	< 6,0	EN 15484 EN 15492
Copper	mg/kg	<0,1	EN 15488 EN 15837
Phosporus	mg/kg	< 0,15	EN 15485 EN 15837
Sulphur	mg/kg	< 10	EN15485 EN 15486
Sulphates	mg/kg	< 4,0	EN 15492
Volatile content	mg/100 ml	<10	EN 15691

Product specification from dehydration



Analysis	Unit	Limit	Method
Color		Clear and without color	EN 15769
Total Acidity (as acidic acid)	m/m%	< 0,007	EN 15491
Ethanol content	m/m%	> 98,7	EN 15721
More saturated carbons (C3-C5)	m/m%	< 2,0	EN 15721
Methanol	m/m%	< 1,0	EN 15721
pHe		6,0-9,0	ASTM D 6423
Unorganic clorides	mg/kg	< 6,0	EN 15484 EN 15492
Copper	mg/kg	<0,1	EN 15488 EN 15837
Phosporus	mg/kg	< 0,15	EN 15485 EN 15837
Sulphur	mg/kg	< 10	EN15485 EN 15486
Sulphates	mg/kg	< 4,0	EN 15492
Water content	m/m%	<0,300	EN 15489 EN 15692
Conductivity	uS/cm	<2,5	EN 15938
Volatile content	mg/100 ml	<10	EN 15691

Estimated content in Process Sewer water to water treatment plant

Analysis	Unit	Min	Normal	Max	Amount Kg/day
pH		6	7	9	
Total phosporus	mg/l	0,2	2,5	5	0,03
Total Nitrogen	mg/l	2,5	30	56	0,41
COD	mg/l	6800	8500	13000	116
BOD7	mg/l	5900	6500	10700	89
Total solids	mg/l	10	100	200	7

