IEA Bioenergy
Technology Collaboration Programme

Biobased gasoline from sawdust via pyrolysis oil and refinery upgrading

Bioenergy Success Stories

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Year of implementation:	2021
Location:	Sweden
Technology:	Pyrolysis; Co-refining in FCC (fluidized catalytic cracking)
Principle feedstocks:	Sawdust, domestic
Products/markets:	Transport fuel
	Design capacity: 25 000 ton pyrolysis oil/year (current pyrolysis plant), 100 000 ton pyrolysis oil/year (total co-processing potential of the Lysekil cracker)
Technology Readiness Level (TRL):	TRL 7 – system prototype demonstration in operational environment

DESCRIPTION

At the Pyrocell facility in Gävle, Sweden, saw dust is converted to pyrolysis oil. Pyrocell is a joint venture between the refinery company Preem and the wood industry company Setra. The pyrolysis plant is situated at the Setra Kastet saw mill and has just been commissioned; production started in September 2021. The facility is designed to produce about 25 000 ton of biobased pyrolysis oil per year and the target is that all this pyrolysis oil will be upgraded to renewable fuel at Preem's refinery in Lysekil, Sweden.

The first short-term test of feeding pyrolysis oil to the fluidised catalytic cracker (FCC), where the upgrading to bio-gasoline is to be performed, has recently been performed at the Lysekil refinery. In this test, 300 ton of pyrolysis oil was treated as a mixture of 2 percent pyrolysis oil and 98 percent fossil feedstock. The test lasted a couple of days and showed that the quality of the produced gasoline and diesel was not affected by the pyrolysis oil. This is important, since a known issue with biobased gasoline is that at high ratios of renewable feedstock, the octane number of the gasoline may become too low, leading to engine knock in the car. This is caused by a lower content of aromatic hydrocarbons in the bio-gasoline. The exact amount of aromatics produced during industrial scale FCC processing of pyrolysis oil still remains to be investigated, but at two percent co-refining the gasoline quality has thus been shown not to be an issue.

Bio-based pyrolysis oil differs from fossil oil in many ways, for instance through a high viscosity, a high density and a low pH. It is also not miscible with fossil feedstock, due to the high oxygen content. The inorganic content also differs from fossil oils; bio-based pyrolysis oil contains chlorides and metals such as sodium, potassium, magnesium and calcium. This could potentially lead to corrosion of the equipment at the refinery, and Preem has installed monitoring equipment to track how the equipment is affected by the pyrolysis oil.

The next step in this venture is to perform a long-term test where 50 000 ton of pyrolysis oil will be processed during two years. This corresponds to two years of pyrolysis oil production from the Pyrocell pyrolysis plant and will result in approximately 25 000 ton of renewable products, mainly gasoline.

Picture of the Pyrocell pyrolysis plant in Gävle, Sweden.

Stakeholders involved:	Pyrocell AB (pyrolysis), Preem (co-refining, owner of Pyrocell), Setra (provider of saw dust, owner of Pyrocell), the Swedish Environmental Protection Agency (co-financer of the pyrolysis plant), the Swedish Energy Agency (co-financer of the co-refining demonstration project)
Contribution to Sustainable Development Goals:	SDG 7: Local lignocellulosic by-product used to produce transportation fuel. SDG 8: The use of biomass for energy purposes generates new jobs along the forest value chain. Renewable feedstock in refineries is needed for the refinery industry to survive in the long term. SDG 12: Transportation fuels and petrochemicals produced from lignocellulosic biomass can substitute fossil resources in a sustainable way. SDG 13: Reductions in the use of fossil oil.
Employment:	About 12 employees working in the pyrolysis plant. In the long term, developing renewable alternatives to process in existing refineries is a requirement for the refinery industry to survive.
Replicability and scale-up potential:	The Lysekil cracker can co-process about 100 000 ton pyrolysis oil per year with the current quality and properties of the pyrolysis oil. It is likely that similar crackers around the world could follow this example and process similar amounts, if pyrolysis oil is available in large enough quantities.
Success factors:	Continued implementation requires legislations that demand increasing amounts of renewables in transportation fuels. Furthermore, the sustainability criteria of forest industry by-products such as saw dust are important for this route.
Constraints:	Today, there is an upper limit on the share of pyrolysis oil which can be co-refined in an FCC unit. To further increase the renewable fraction of the bio-gasoline, more technology development is needed.
Info provided by:	Linda Sandström, RISE
More information:	https://www.setragroup.com/en/pyrocell/ https://www.preem.com/in-english/press/ http://www.energimyndigheten.se/forskning-och-innovation/projektdatabas/sokresultat/?projectid=31057