



By introducing a renewable feedstock at the front end of a refinery, Ensyn is producing spec transportation fuels without the challenges of blends and blendwalls

Cellulosic game changer

A key focus for growth in the biofuels industry is to find solutions for the conversion of lignocellulosic biomass to usable fuels, in particular transportation fuels such as petrol and diesel. This search has accelerated in recent years as ethanol and biodiesel alternatives approach limits to growth related to blendwalls and the food-vs-fuel issue.

The emphasis on cellulosic fuels is clearly evidenced in the structure of various government regulatory programmes, including the Renewable Fuel Standard (RFS2) administered by the US Environmental Protection Agency (EPA), which calls for the lion's share of growth in liquid biofuels to come from cellulosic, non-food sources over the next decade.

Within the cellulosic biofuels sector there have been a few notable disappointments but one company that is emerging as a key player in this space is private US company Ensyn, which was initially established in Ottawa, Ontario, Canada.

Ensyn's patented RTP conversion technology is a fast thermal process that converts solid biomass (principally wood residues) into high yields of a liquid fuel known as RFO. The RTP process does not require catalysts, hydrogen or significant pressure, characteristics that allow for low capital and operating costs and small minimum economic scale. The technology produces liquids from lignocellulosic feedstocks such as wood residues with a yield of approximately 70% (wt% from dry feed). The balance consists of by-product char and gas, both of which are used as fuel sources in the production process.

Ensyn's RFO is essentially 'liquid wood'. It has multiple applications, although Ensyn's current business plan is focused on two applications in particular: heating and refinery feedstocks. RFO is a heating fuel that directly displaces petroleum heating fuels, including #6, #4 and #2 fuel oil, and it is also a renewable feedstock for

conventional refineries for the production of petrol and diesel in an application known as Refinery Coprocessing.

RFO as refinery feedstock — Refinery Coprocessing

Refinery Coprocessing represents a game-changing approach to the production of petrol and diesel from solid biomass. It involves the feeding of RFO directly into the fluid catalytic cracker unit (FCC) at conventional refineries, alongside conventional FCC feedstocks (e.g. vacuum gasoil), in proportions of up to approximately 5%. The net result is the production of spec petrol and diesel.

After a number of years developing Coprocessing, Ensyn is now working to commercialise the application in conjunction with UOP, a Honeywell company and specialist in FCC technology. Multiple trials have been carried out by independent entities in Canada, the US, Europe and South America, including UOP, government

agencies, independent laboratories and major oil companies. These demonstrations have taken place in facilities ranging from small-scale FCC test equipment to large pilot and demonstration facilities, as well as in commercial FCCs.

To date, this work has resulted in strong overall yields of petrol and, in particular, diesel, and an attractive overall balance of products. Indications are that the value of RFO in a Coprocessing application, based on standard linear programming methodologies, is comparable on a volumetric basis to the value of the vacuum gasoil that it displaces.

Coprocessing represents a straight forward solution for refineries seeking to integrate cellulosic biofuels into their product mix. It allows cellulosic biofuels targets to be met using existing refinery and downstream infrastructure, avoiding the need to build expensive dedicated upgrading infrastructure and downstream blending and distribution.

While ethanol and biodiesel



Ensyn's cellulosic biofuel production plant in Renfrew, Ontario

are blended into the petrol and diesel pools post refining (and are subject to blend limits), Ensyn introduces its RFO as a renewable feedstock at the front end of a refinery. The end-product is spec petrol and diesel, not a blend.

In early 2015, Ensyn will finalise commercial demonstrations of Coprocessing, and this will be followed by signing contracts with refiners for the commercial supply of RFO. Initial commercial deliveries to refiners are expected to be met from Ensyn's existing production capacity. This would be followed by production from new plants the company is currently developing in Canada, Brazil and the US.

Regulatory benefits

The use of RFO is eligible under the EPA's RFS2 programme for the generation of D3 and D7 cellulosic RINs when used for Coprocessing, and D7 RINs when used for heating. Ensyn is the first company to generate cellulosic RINs under the EPA's expanded definition of 'heating oil' under RFS2, which became effective last December. It generates D7 RINs by replacing petroleum heating fuels (including #6, #4 or #2 diesel fuel oil) with RFO in customers' boilers.

In Coprocessing, D3 and D7 RINs will be generated by the refiner at the refinery,

providing advantageous control over RIN generation, as opposed to RIN generation at blending stations downstream of the refinery.

Capacity expansion

To date, the RTP technology has been responsible for over 37 million gallons of commercial production. Numerous RTP facilities have been built over a period of 25 years, six of which are in operation today.

Current RTP installed capacity consists of five facilities in Wisconsin, US focused on the production of liquids for chemicals and heating fuels (owned by Red Arrow, Ensyn's food ingredients partner) and

Ensyn's own RTP plant located in Renfrew, Ontario.

Ensyn has initiated its fuels build-out by enhancing its facility in Ontario and converting it from a chemical and fuels plant to a dedicated fuels plant. This work, with a focus on enhancing production capacity, automation and efficiency, was completed in October 2014. The unit can now produce approximately 3 million gallons per year (mgy) of RFO. Offtake from this facility is being directed to satisfy contracted commitments for heating fuels and to provide RFO for commercial demonstrations of the refinery business.

Additional RTP production capacity is under development.

These new builds are slightly larger, ranging from 5 to 20 mgy. These include a 20 mgy facility in Aracruz, Brazil (with partner Fibria Celulose) and additional projects in Quebec, the US and Malaysia.

Ensyn is executing its business plan with key strategic relationships, including UOP, Chevron Technology Ventures, Fibria, Credit Suisse, Petrobras, and the US National Renewable Energy Lab (NREL). Ensyn's business model for the project is to build-own-operate, together with strategic partners, including fibre owners such as Fibria. The RTP units for these projects are being supplied to the projects with performance guarantees by Envergent Technologies, a joint venture between Ensyn and UOP. Envergent is developing additional RTP initiatives in other countries, including Finland.

The biofuels industry is seeking viable solutions for the conversion of non-food, lignocellulosic feedstocks to usable liquid fuels. With its de-risked RTP conversion technology, combined with a novel refinery application and strategic partners, Ensyn is at the forefront of development. ●

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Ensyn has recently completed an upgrade of its Ontario facility, increasing production capacity to 3 mgy