Science Show

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Boost for biodiesel potential

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The search is on to develop materials for biodiesel which don't use crops best used for food, and which don't use farmland on which crops for food could be grown. Tallow is the fat produced when animals are processed in abattoirs. The Materials and Energy Group at Flinders University has developed technology to ensure biodiesel blended with tallow remains liquid at usual operating temperatures. This technology can also be applied to jetfuel biofuel which needs to remain liquid at temperatures as low as 50°C.

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Robyn Williams: If you boil up the carcasses of cattle or sheep you get tallow, and that could be a prime source of fuels. It's an industry potentially worth billions if you can keep the fluids liquid, even at low temperatures. Here's Stephen Clarke at Flinders University in South Australia.

Stephen Clarke: Tallow is basically the fat that comes out of the rendering process of meat and sheep when it's processed by the abattoirs.

Robyn Williams: And what normally happens to it?

Stephen Clarke: In the past it's widely been used in a variety of applications; making soap and cosmetics. But that use has declined and the price of tallow has dropped, so the meat industry was looking for alternative options, and converting the tallow into biodiesel was a good opportunity. Most of the biodiesel plants in Australia actually use tallow as a feedstock.

Robyn Williams: And if they couldn't sell it to biodiesel people, were they turfing it?

Stephen Clarke: No, they were still selling it but the price had dropped to $400 a tonne which was a very low price, and at that price it also made conversion into biodiesel a good option because fuel was selling for around $1.00 - $1.10 a litre at that time when it was at that price.

Robyn Williams: And I suppose the advantage is you've got it all in one place so you don't have to transport it gigantic distances, and you get sufficient supply and constant supply so you can provide for an industry.

Stephen Clarke: That's right. There's actually enough tallow produced in Australia to meet about 10% of Australia's diesel needs if it was all converted into biodiesel.

Robyn Williams: And converting it is the problem, isn't it, because at low temperature it's solid.

Stephen Clarke: Yes, if you make what's called B100 biodiesel out of tallow, which is the 100% biodiesel, it has a freezing temperature of between 10°C and 15°C, depending on the actual chemistry make-up of that feedstock. This is the main reason why tallow based biodiesel is blended into normal diesel and sold as maybe B5 or B10. We developed a technology that was able to push the freezing temperature of that blend from about 1°C down to about -6°C, and this meant that the properties of the biodiesel blend was very similar to normal diesel that's used in Australia in winter conditions.

Robyn Williams: So you don't want the fuel in your tank going solid like lard because that would be counterproductive.

Stephen Clarke: Yes, it basically turns into a waxy solid and it would freeze up your tank, so you obviously don't want to have that in the middle of winter.

Robyn Williams: Of course that's one of the main problems with getting a new fuel for aircraft because at high altitudes it's even lower, it's something like -40°C, and that's why kero is the only option so far.

Stephen Clarke: Yes, that's right. We've also been working in that area with a different type of B100 biodiesel and we've been able to push the freezing temperature of that down to -55°C, and the specification for jet fuel, what's called jet A1 fuel, is -47°C. So we think we've got something that's quite promising.

Robyn Williams: That's very interesting because Richard Branson has been talking about that for his aircraft so that you can get biodiesel which is reliable and stable to use on a constant basis, because you don't want your fuel to fail up there in the sky.

Stephen Clarke: No, that's right. One of the fuels that's been used in that area is made from what's called Jatropha which is a generation-two feedstock. On its own it's not suitable and you can't even convert that into biodiesel, it can be used in jet fuels, but in America they've developed a technology where they hydrogenate the Jatropha and then they put it through a normal refining process. They basically convert the Jatropha oil to a normal petroleum type product, and then they distil it and extract the jet fuel type component. Air New Zealand and Boeing are doing trials on that material at the moment, they're doing in a 50-50 blend.

Robyn Williams: Jatropha is in fact a tree that grows very nicely in Australia in the wastelands.

Stephen Clarke: Yes, that's right. One of the issues with Jatropha is that some of the state governments class it as a noxious weed so we actually can't grow it in Australia, yet it's being grown all around the world in India, Africa and some of the Asian countries as a feedstock for biodiesel.

Robyn Williams: Yes, but some different species grow wild as well, don't they, here?

Stephen Clarke: Yes, I think the Australian government is concerned about it growing out of control.

Robyn Williams: Okay, here you are looking at the future of biodiesel and you're working from Flinders University and trying to lower temperatures. Are you able to give me the secret?

Stephen Clarke: I can't tell you how we lower the temperature but essentially the oil is converted by what's called a transesterification reaction, it is reacted with a base catalyst and methanol, and for every ten litres of tallow or starting material you start with, you end up with ten litres of biodiesel, and you end up with one litre of glycerol as a by-product. Unfortunately in Australia most of them were burning that by-product, some were converting it into pharmaceutical grade glycerine, but you can actually use that as a platform chemical to make a whole range of new chemicals like plastics and pharmaceutical drugs and so on.

And if you consider...we use 15 billion litres of diesel in Australia. If we were to replace that with 15 billion litres of biodiesel, we would be producing 1.5 billion litres of glycerol as a by-product. You can use this to be producing value added products, maybe selling at $10 or $20 a litre, that underpins the operation of the biofuels industry. And this is exactly what the petroleum industry has been doing. About 15% out of every barrel of crude goes towards petrochemicals, which are high profit, high value or value added products that underpin the sale of fuel in the petroleum fuel industry. Yet the biofuels people in Australia and around the world don't do that, they just focus on trying to produce a low profit margin, high volume product. And that's why the industry struck troubles last year and essentially the Australian biodiesel industry collapsed because prices of feedstock went up and they didn't have the buffer of what we call a value added bio-refinery industry to buffet the...

Robyn Williams: And there are only about two plants going at the moment.

Stephen Clarke: Two major plants going in Australia, yes.

Robyn Williams: Where are they?

Stephen Clarke: One's in Victoria and I think one's near Albury.

Robyn Williams: So the second question about biofuels, apart from the chemistry, the secret of which you'll tell me one day quietly but we've got the principle; is a reliable supply not conflicting with arable land and growing food. So what you're looking at is stuff that is waste that is reliable and in substantial supply, and you're saying that that can be the basis for a substantial biofuel industry in Australia.

Stephen Clarke: Yes, that's one component of it. The other component is the agricultural feedstocks for making biofuels are called generation-one or gen-one feedstock. There's also a strong push to move towards the gen-two or generation-two feedstocks, and micro-algae is seen as an opportunity. Micro-algae has the opportunity of providing lipids or oils or fats for biodiesel. They can also produce starch for ethanol production, and in some cases you can even produce hydrogen, so for the hydrogen economy, the generation-three cars, the battery cars that we've been hearing so much about.

And the beauty with the generation-two micro-algae processes is that the land needed is about one-thirtieth of the land that you need for generation-one biofuels. To give you an example, if America was to produce all of its ethanol from corn production, they would need 8.5 times the area of crop land that they use at the moment just to meet their fuel requirements, which obviously is not feasible. So you've got to look at alternatives, and the generation-two feedstocks like cellulosic feedstocks and the micro-algae feedstocks provide you that opportunity to get the quantity. At the moment the price of those fuels are too expensive, so it needs a lot of research to help drive the cost down to make it feasible. But once that's achieved then basically we can overcome the problems of petroleum fuels.

Robyn Williams: So in five or ten years time do you expect biofuels to have taken off, if people have got good sense?

Stephen Clarke: Yes, I think that's the sort of timeframe that we're looking at is probably five to ten years. Typically the price of oil coming from micro-algae at the stage...and the technology is there, it works, it's just the price is around $5 a litre, which obviously when you're competing against crude at 30c - 40c a litre is not the best. It's a bit like the colour television; when that first came out it was selling for $2,000, $3,000 a set, and now we can buy colour televisions for $300 or $400. So as we develop the technology and improve the processes I think the prices will come down and it should be competitive with petroleum fuels.

Robyn Williams: Dr Stephen Clarke is leader of the biofuels group at Flinders University in Adelaide, and he estimates the industry could be worth $50 billion a year to Australia.

Guests

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