

Water-biodiesel cocktail

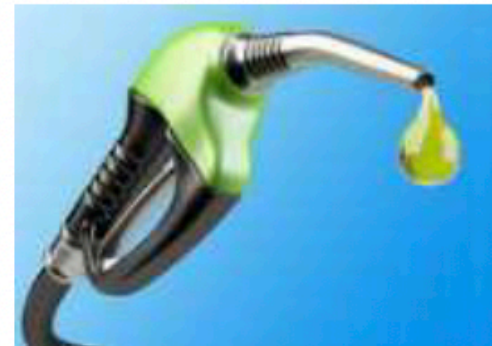
Team Quantum

Using biodiesel to run truck engines can help reduce automotive greenhouse gas emissions, but the problem is that biodiesel releases more nitrogen oxide emissions than fossil diesel does. It further has a lower calorific value, which means you need more of it in your tank.

Scientists say mixing water with biodiesel addresses these problems. You get better engine performance, lower emissions and less soot. A recent scientific paper published in *Fuel* magazine describes this in scientific terms: “Early vaporisation of water inside the fuel droplet increases its temperature, thus resulting in a phenomenon called ‘micro-explosion’, which in turn results in small fuel fragments, thus improving air-fuel mixing and reducing soot formation.”

But mixing water with diesel — bio or otherwise — is counter-intuitive, because the two don’t mix.

However, getting them together is not an insurmountable problem — you need an



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emulsifier, which is usually one of the chemicals that are called surfactants. Usually, a mixture of surfactants called Span80 and Tween80 is used for this purpose, says the paper, which is titled ‘Novel surfactants for stable biodiesel-water’, authored by Sudarshan Gowrishankar and Prof Anand Krishnasamy of the Department of Mechanical Engineering, IIT-Madras.

But Span80-Tween80 is for diesel — you’d need a different concoction for biodiesel. The stability of the emulsifier is critical because you can’t afford to have water separate from the oil, which would bring its own problems such as corrosion, Prof Krishnasamy told *Quantum*.

So, Gowrishankar and Krishnasamy prepared a new emulsifier — a cocktail of Span80-Tween80 and two

novel surfactants, polyglycerol poly ricinoleate (PGPR) and raw karanja oil (RKO). The karanja (*Pongamia pinnata*) tree’s merits were earlier discussed in these columns (‘Tree of Sustainable Life’, *Quantum* dated October 16, 2022).

PGPR is a commercially available low-cost food ingredient. RKO is a tree product. The novel surfactant is, therefore, a viable one. First, the researchers tested the stability of the surfactant. “We carried out experiments with the new emulsions on a light-duty diesel engine at rated speed and varying loads,” Prof Krishnasamy said. The researchers found that their cocktail worked well.

Next, the challenge is to find the optimum mix of water and biodiesel, with the surfactant thrown in. More water means reduced tailpipe emissions, but also lower heat content of the fuel.

They found that the optimum water concentration is 18 per cent, which reduced nitrogen oxide by 40 per cent, smoke by 52 per cent and carbon monoxide by 69 per cent.