

Oil in: vegetable beats mineral

CPFL Energia, Brazil's largest privately owned energy company, is transitioning its entire distribution network to greener technology. Manager of maintenance and standards Caius Vinicius Sampaio Malagoli discusses how **Cargill's** FR3 vegetable-oil fluid is paving the way for a generation of more economical, ecological and secure transformers.



Vegetable oils are an alternative to other vegetable and petroleum oils in non-food applications.

The 2014 FIFA World Cup saw all eyes lock onto Brazil, examining everything from transport to housing. Though there are numerous aspects of its economy that have come under criticism, South America's largest country has still demonstrated its admirable green credentials – as the world's third-largest producer of renewable energy and second-highest producer of renewable electricity.

Recent reports claim that over 82% of Brazil's total electricity production was generated sustainably. And with the world's largest fresh water supply, it's unsurprising that hydroelectric electric power plants cater for over 90% of its electricity consumption.

CPFL Energia, Brazil's largest privately owned electricity producer, is responsible for serving over 569 towns and cities throughout the south of Brazil, supplying energy to over seven million households and businesses. It too harbours ambitions for sustainable energy and has recently committed its entire distribution network to green transformer technology.

"We were using mineral oil in our transformers throughout Brazil, but we wanted to look for something more economical and environmentally friendly," says Caius Vinicius Sampaio Malagoli, manager of maintenance and standards at CPFL. "The green transformer initiative arose inside the engineering department; we started to conduct research into vegetable oil to look for a more efficient alternative."

Oil you need

In 2002, CPFL began research into the properties of nine oil types. Four years later, the pilot project was launched, comparing the reliability of transformers using natural esters with those containing ordinary mineral-oil-based fluid. The most reliable solution proved to be the FR3 natural ester fluid produced by Cargill, a global provider of agricultural, financial, and industrial products and services.

"This was actually a collaborative mission with Cargill, which has been a partner of ours throughout the project," says Malagoli. "The initial interest in vegetable-oil-based fluids stemmed from our dissatisfaction with mineral oil, particularly its handling risks and leakages, not to mention the difficulty in safely disposing of expired transformers."

Natural ester fluid

Cargill's FR3 natural ester fluid is now used in over 600,000 distribution and power transformers worldwide. Due to its higher thermal capacity, it allows for a more compact, energy-efficient and environmentally friendly transformer. Containing no petroleum, halogens, silicones or sulphurs make the oil non-toxic, renewable and able to biodegrade in fewer than 28 days. It emits 56 times less carbon than mineral oil and is suitable for use in highly populated regions or those located near waterways, parks or other outdoor community areas.

The FR3 fluid has a high flash and fire point, and it would need to hit twice the temperature of mineral-oil fluids before igniting, and even then it possesses self-extinguishing properties. Though less likely, if the green transformers were to leak, the cleanup process is significantly easier and cheaper than dealing with mineral-oil spillages.

"That was a benefit we hadn't initially anticipated," says Malagoli. "As an energy distributor, our first concern is safety. We started to realise that vegetable oil would not only be environmentally advantageous as a replacement for mineral oil, but that it could also provide technical advantages for the equipment itself, as well as significant gains in operational efficiency and costs."

FR3 fluid

One of the most common causes of failure in electrical transformers is the degradation of the solid insulating system (cellulose paper). Unlike mineral oil, the FR3 natural ester



Opened in 2011, the Cargill Latin American Innovation Center focuses on R&D in several areas. With 21 scientists, the center's focus is innovation and applications development in the areas of new product development, prototype elaboration and product optimisation, among other services offered.

fluid has the benefit of being hygroscopic – it retains water and protects the insulation from degradation for approximately eight times longer.

“A combination of these factors has allowed us to make significant gains from the reduction of maintenance costs,” says Malagoli. “We can get the same performance as we would from a mineral-oil transformer, but using less material and with the advantage of having more compact, cost-effective equipment.”

As well as Cargill, CPFL also worked extensively with B&M (technology partner) and ITAIPU Transformadores (transformers industry) throughout the process.

“They manufacture the green transformers and proved to be a key partner in developing the solution from the very beginning, helping with the design, fabrication and testing of the machine” says Malagoli. “The project has exceeded our expectations technically, and in terms of its benefits to power, quality, safety and the environment.”

The future's bright, the future's green

After a decade's research, development and testing, 5,000 of CPFL's green transformers are now operating on Cargill's FR3 fluid. Such is its success, CPFL plans to transition 100% of its units over to the fluid, making it the nation's largest user.

“Over the course of 2013, we had innumerable debates, discussions and presentations around the decision, assessing the advantages and evaluating the risks. But, ultimately, we decided to purchase 100% of our new transformers using vegetable oil,” says Malagoli.

“One of the biggest challenges faced at the beginning of the project was how little application there had been of this type of insulating fluid in Brazil. We were the first company in Brazil to

lead a project to develop a new distribution transformer exploring the greater heat capacity of vegetable oil.”

For it to be deemed a success, the green transformer had to outperform alternatives and cost less to manufacture, presenting perhaps the project's most significant challenge.

“Naturally, if the cost was too high, introducing them would be difficult, regardless of the advantages. It would have happened at a much slower pace,” says Malagoli. “But we managed to achieve our operational and financial targets, which is essential. Now we're working hard to make them economically viable to other potential clients and suppliers.”

Malagoli and his team are not the only ones to be impressed with the outcome of the project. In 2012, CPFL received an award for its work in sustainable innovation from the prestigious National Fund for Scientific and Technological Development (FINEP).

“It has produced immeasurable value to our brand, peer acknowledgement and interest in our company,” says Malagoli. “Whenever we receive visits from foreign businesses and institutions, we include the green transformer in our presentations – it invariably piques the interest of our visitors.”

For Malagoli, abandoning mineral oil altogether is simply the logical next step. It is indicative of CPFL's commitment to sustainability, and such is his faith in the project, he fully expects other energy companies to follow suit throughout Brazil. As one of the world's largest energy producers, the implications of this trend would be far reaching, and not just confined to the South American continent. ■

Further information

Cargill
envirotempfluids.com

