VEGETABLE AND SYNTHETIC OILS SAFEGUARD ELECTRICITY SUPPLIES

Research shows that vegetable and synthetic oils can make transformers safer and cleaner.

As transformers convert electricity supplies from one voltage to another they get hot due to power loss. So a transformer is bathed in insulating mineral oil which helps to dissipate the heat and keep everything cool and safe.

But here is the paradox: mineral oil is flammable. So if a transformer malfunctions and the oil overheats, you may end up with a catastrophic fire, not to mention a serious power blackout.

Professor Zhongdong Wang and her team from the School of Electrical and Electronic Engineering have been working on a safer alternative: vegetable and synthetic oils. Although these oils have been used in low voltage transformers for decades, the examinations done at the University of Manchester have shown that they are also safe for use in high voltage transformers.

"Known as esters, vegetable and synthetic oils can survive temperatures up to 350°C - more than double that of mineral oil," explains Professor Wang. "They are also renewable and readily available."

The Electrical Energy and Power Systems research group at Manchester analyses the performance of ester liquids under electrical and thermal stresses similar to those endured in high voltage transformers.

"It is important to understand the long term performance of esters," says Professor Wang. "In the laboratory we mimic the stresses that esters will endure throughout a transformer's lifespan. We predict the point of failure."

These rigorous tests use Manchester's lightning impulse generator – the largest in the UK – to examine how the esters will perform if the transformer is struck by lightning. "The risks and consequences of transformer fires are high," explains Professor Wang. "We must take all precautions."

The use of esters as electrical insulation requires a modification in the design of transformer because these new liquids behave differently to mineral oils. The

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Project: Application of environmentally friendly and fire-safe ester liquids in high voltage power transformers

Manchester researchers advise industrial partners on how they can design equipment to handle esters.

National Grid, the UK power transmission system operator, recently revised its transformer oil policy to permit use of ester liquids.

Alstom Grid, the third largest transformer manufacturer in the world, applied Manchester’s research to become the first UK company to design and build an ester-filled high voltage transformer. Today, the company offers a range of ‘eco-efficient’ ester-based transformer products.

EDF Energy (now UK Power Networks) also applies Manchester’s research: it is the first utility company to run a ‘green’ 132kV transformer containing only natural, biodegradable ester liquids from sustainable sources.

“The transformer is insulated with 30,000 litres of Envirotex FR3—a natural ester which we analysed here at Manchester,” says Professor Wang. “Made from soya beans, the ester is environmentally friendly and is even expected to increase the lifespan of the transformer.”

The capacity for ester liquids to protect the environment and reduce fire hazards is huge: if ester-filled transformers gradually replace their mineral oil counterparts, it will bring a significant reduction on the annual need of 5.5 million litres of flammable and non-biodegradable mineral oil.