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2P76 - C5F10O/N2 GAS MIXTURE TO SUBSTITUTE SF6 IN HIGH VOLTAGE APPLICATIONS

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In recent years, C5F10O has become one of the most promising alternatives to SF6.Not only because it fundamentally solves the issue of greenhouse effect of SF6 with the GWP of 1, but also, thanks to its high content of fluoride, the insulating strength of C5 is twice as good as SF6.However, the liquefaction temperature of C5 is 27℃ under normal pressure, so the most crucial challenge for it is the liquefaction case for high voltage application.
In this paper, N2 is added to C5 to reduce its liquefaction temperature. Refer to the practical application, the scheme of C5 mixed gas instead of SF6 is explored combining with liquefaction temperature and the concentration of C5.Firstly, the saturated vapor pressure of C5/N2 gas mixture at different temperatures and molar concentrations was calculated by using Antoine equation and gas-liquid equilibrium law. The results reveal that 2%C5/98%N2, 5%C5/95%N2and 8%C5/92%N2 liquefied at 0.7MPa, 0.3MPa and 0.2MPa under the lowest operating temperature of GIS(-15℃)respectively. And then, the breakdown voltage of mixture with different concentration in critical conditions is measured under AC voltage. Furthermore, the LM algorithm is used to fit the function with gas pressure P and molar ratio K. It demonstrates that under the saturated vapor pressure, the insulation strength of 2%C5, 5% C5,8%C5 gas mixture can reach up to 78%, 56% and 43% of SF6 at 0.5MPa.Therefore, increasing the pressure is a more effective way to improve the insulation strength of C5 mixture than ratio.

In summary, the paper indicates the mixture of 2%C5/98%N2 at 0.7MPa is expected to replace SF6 at 0.5MPa in GIS, which provides an important reference for the substitution of C5 in high voltage application.

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