THERMAL STABILITY OF A MIXTURE OF LINEAR SILOXANES

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ABSTRACT

The thermal stability of the working fluid is a key aspect for the design of an efficient organic Rankine cycle. Several studies claim that the use of zeotropic mixtures of organic compounds may lead to an improvement of maximum cycle efficiency with respect to the use of pure fluids. Therefore the assessment of thermal stability of organic fluid mixtures, in comparison with the one of each single constituent, is crucial in order to design high performance cycles. However, scarce experimental data are currently available about the thermal stability of such mixtures. To fill this gap, an experimental campaign was carried out at CREA Laboratory of Politecnico di Milano (Italy) on linear siloxanes MM and MDM and on equimolar mixtures of MM/MDM. Linear siloxanes were chosen due to their wide employment as pure working fluids in high temperature organic Rankine cycles.

During a single test, a sample of the fluid under scrutiny is placed in a closed vessel and stressed at constant temperature of 350 °C, 390 °C and 420 °C for 80 hours. Two different methods for decomposition analysis were applied. The first is based on the comparison of the vapor pressure curve of virgin and stressed fluids [1]. If present, the deviation between the curves provides an indication of the decomposition extent. The second method is based on the comparison of the virgin and stressed fluid composition, measured, for both liquid and vapor phase, by means of gas chromatography and mass spectrometry. The latter method permits to obtain a trend of the sample composition for varying stress temperature, whereas by using the vapor pressure method, the quantitative relation between deviation and entity of decomposition cannot be easily retrieved.

Using both methodologies, the stability of pure compounds was compared to the one of the equimolar mixture. In addition, the identification of decomposition products and of their mass fraction was carried out through gas chromatography-mass spectrometry.

References:

[1] M. Pasetti, C. M. Invernizzi, P. Iora, Thermal stability of working fluids for organic Rankine cycles: An improved survey method and experimental results for cyclopentane, isopentane and n-butane, Appl. Therm.481 Eng. 73 (1) (2014) 764 – 774