

# A New Static Analytic Apparatus for Complete Determination of Phase Equilibrium Data from Sub-Atmospheric Pressures up to 10 bar

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## Abstract

Reliable experimental acquisition and validation of Vapor-Liquid-Equilibrium (VLE) data are of great importance for the design and optimization of purification processes. For processes operating from sub-atmospheric conditions to moderate pressures (between 1 and 5 bar), existing experimental techniques show some drawbacks. The static synthetic method is very commonly used, while thermodynamic models are required to deduce phase compositions<sup>1</sup>. Proper design for recirculating stills may extend the ability from sub-atmospheric pressures to moderate pressures<sup>2</sup>. However, typical limitations of recirculating stills, such as large system volume and cooling duty for highly volatile compounds, are retained.

In order to meet the growing demands of complete Vapor-Liquid-Equilibrium (VLE) data, a new apparatus capable of measuring  $P$ - $T$ - $x$ - $y$  data from sub-atmospheric pressures up to 10 bar has been developed. The apparatus is based on a static-analytic method with *in-situ* phase sampling, using a gas chromatograph for on-line sample analysis. The configuration of the new apparatus is similar to that described by Laugier and Richon<sup>3</sup> with improvements. The key feature is a new mechanism coupled with the ROLSI<sup>TM</sup> capillary sampler to achieve liquid phase sampling at both sub-atmospheric and moderate pressures. This assembly is the subject of a patent recently submitted<sup>4</sup>. A six-port valve is combined with the sampler for vapor phase sampling<sup>5</sup>.

The newly developed VLE apparatus was tested against other commonly employed techniques in this pressure range on selected binary systems. The new apparatus achieved better performances compared to existing experimental methods, as it is able to provide complete phase information ( $P$ - $T$ - $x$ - $y$ ) in both sub-atmospheric and moderate pressure ranges.

## Reference:

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