



Ain Shams University  
Faculty of Science

# **Experimental Studies on Constant Volume Depletion of Gas- Condensate Systems**

**A thesis submitted for the fulfillment of Master  
Degree of Science in Analytical Chemistry**

**BY**

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B. Sc. of Chemistry (2005)  
Faculty of Science  
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## ABBREVIATION

### List of Symbols Description

<b>API</b>	<b>American Petroleum Institute</b>
<b>bbl/d</b>	<b>Barrels per day</b>
<b>CMD</b>	<b>Constant Mass Depletion</b>
<b>CVD</b>	<b>Constant Volume Depletion</b>
<b>FID</b>	<b>Flame ionization detector</b>
<b>GOR</b>	<b>Total Gas to Oil Ratio , SCF/STB</b>
<b>GOR<sub>diss</sub></b>	<b>Dissolved Gas to Oil Ratio , SCF/STB</b>
<b>GOR<sub>sep</sub></b>	<b>Separator Gas to Oil Ratio , SCF/STB</b>
<b>IDS</b>	<b>Interface Detection System</b>
<b>LDO</b>	<b>Liquid Drop Out</b>
<b>Ln</b>	<b>Natural logarithm (base e)</b>
<b>M<sub>C7+</sub></b>	<b>The Molecular Weight of heptanes plus</b>
<b>P</b>	<b>Pressure</b>
<b>P<sub>ci</sub></b>	<b>Critical pressure of component i, psia</b>
<b>P<sub>pc</sub></b>	<b>Pseudocritical pressure, psia</b>
<b>P<sub>d</sub></b>	<b>Dew point pressure , psia</b>
<b>PIONA</b>	<b>Paraffin , Isoparaffin , Olefin , Naphthine and Aromatic</b>
<b>P<sub>pr</sub></b>	<b>Pseudoreduced pressure of the gas mixture, psia</b>
<b>P<sub>sep</sub></b>	<b>Separator Pressure ,psia</b>
<b>PR-EOS</b>	<b>Peng-Robinson Equation Of State</b>
<b>PVT</b>	<b>Pressure-Volume- Temperature</b>
<b>R</b>	<b>Universal gas constant</b>
<b>R<sub>sep</sub></b>	<b>Separator producing gas/oil ratio , SCF/SP bbl</b>
<b>SCF/STB</b>	<b>Standard Cubic Feet / Stock Tank Barrels</b>
<b>SRK-EOS</b>	<b>Soave-Redlich-Kwong Equation Of State</b>
<b>T</b>	<b>Temperature</b>
<b>T<sub>ci</sub></b>	<b>Critical temperature of component i , °R</b>
<b>T<sub>pc</sub></b>	<b>Pseudocritical temperature, °R</b>
<b>T<sub>pr</sub></b>	<b>Pseudoreduced temperature of the gas mixture, °R</b>
<b>T<sub>R</sub></b>	<b>Reservoir temperature ,°R</b>
<b>T<sub>sep</sub></b>	<b>Separator temperature, °R</b>
<b>TCD</b>	<b>Thermal conductivity detector</b>
<b>Tcf</b>	<b>Trillion cubic feet</b>
<b>V</b>	<b>Molar volume</b>
<b>(V<sub>g</sub>)<sub>sep</sub></b>	<b>Volume of separator gas at separator condition ,cc</b>
<b>(V<sub>g</sub>)<sub>sc</sub></b>	<b>Volume of separator gas at standard condition ,cc</b>
<b>Y<sub>i</sub></b>	<b>Mole fraction of component i in the gas mixture</b>
<b>Z<sub>sep</sub></b>	<b>Super compressibility factor of separator gas</b>
<b>γ<sub>C7+</sub></b>	<b>Specific gravity of heptanes-plus fraction (air =1.0)</b>

$\gamma_{\text{diss}}$	Average specific gravity of dissolved gas (air = 1.0)
$\gamma_{\text{sep}}$	Average specific gravity of separator gas (air = 1.0)
$\gamma_{\text{g}}$	Specific gravity of reservoir gas
$\beta_{\text{g}}$	Separator gas formation volume factor
$\beta_{\text{o}}$	Shrinkage Volume Factor
$\omega$	Acentric Factor

#### List of Subscript

$C_{7+}$	Property of heptanes plus fraction
$i$	Mole fraction of component $i$ ; in gas mixture
diss	Dissolved Gas
g	Gas
$P_{\text{c}}$	Pseudocritical
Pr	Pseudoreduced
Sc	Standard condition
Sep	Separator

# **ABSTRACT**

## **ABSTRACT**

**Name: Mohamed Abd El-Moniem Mohamed El-Aily**

**Title: Experimental Studies on Constant Volume Depletion of Gas-Condensate Systems**

This study presents new empirical models to estimate dewpoint pressure  $P_d$  and condensate recovery for gas condensate reservoirs as a function of routinely measured gas analysis and reservoir temperature. The proposed models were developed based on field and laboratory PVT analysis data of 202 gas-condensate fluid samples representing different gas reservoirs and wide range of gas properties and reservoir temperatures. Statistical error analysis was used to determine the accuracy of the models. The evaluation shows that the correlation coefficient of  $P_d$  correlation is 0.9896 and of condensate recovery (Liquid Drop Out) is 0.9878. In addition, results of the proposed models were compared with those published in the literature and ensured its success for capturing the physical trend of gas-condensate systems, and consequently is considered as the most reliable one for petroleum industry. The accuracy of the models has been also compared to Soave Redlich Kwong equation of state (SRK-EOS) and Peng Robinson equation of state (PR-EOS). Gas condensate samples not included in the development of the new correlations have been used to check the validity of the proposed models.

### **Keywords:**

**Dew Point Pressure, Condensate Recovery, Gas Condensate, Empirical Correlation, Equation of State.**