Study on the Effectiveness of Ionic Liquid as Low Dosage Hydrate Inhibitor (LDHI) for Flow Assurance in Pipeline.

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CERTIFICATION OF APPROVAL

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Approved by supervisors:

_____ _____

(**Dr Azuraien Jaafar**) (**Dr Khalik M Sabil**)

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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LEE KUO CHUN

ABSTRACT

This research project is an experimental approach to study the effectiveness of ionic liquids as low dosage hydrate inhibitors (LDHI) for flow assurance in pipelines. In addition, this project is also aimed to gain a better understanding about gas hydrates and choosing new potential ionic liquids as LDHI. Gas hydrates are solid crystalline compounds formed by water and molecules like natural components at low temperature and high pressure conditions. Hydrates formation often occur and block gas pipelines which causes production failure and safety hazards.

The conventional method to prevent the formation of gas hydrates is by using large quantities of thermodynamics inhibitors, which is expensive and dangerous to the environment. Thus, suitable new class of ionic liquids such as low dosage hydrate inhibitor(LDHI) that are strong and effective needs to be discovered to replace the conventional method. The criteria of ionic liquids were studied – stabilities, hydrophilic, tuneable organic cations and anions and extremely low vapour pressures.

In this study, parameters such as kinetic rate and induction time need to be experimentally considered and investigated by using High Pressure Kinetics Measurement (HPKM) for bulk volume. Currently for HPKM, the temperature at 273.65 K and pressure at 35bar is selected to be operating condition for the experiment of hydrate formation as data were recorded every second by data acquisition system. This experiment was continued by adding LDHI (0.1wt%, 0.5wt%, 1.0wt %) and using different pressures (25bar, 30bar and 35bar) to test the effects. However, 10.0 wt% high concentration of EMIM BF_4 is used for the study of ionic liquid effectiveness as thermodynamic inhibitors.

The findings of this work will contribute to a more environment friendly and economical hydrate inhibitors for usage in the oil and gas industrials.

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Nomenclature

The following abbreviations and acronyms are used throughout the text:

AA	Anti-Agglomerant hydrate inhibitor
bbl	barrel (42 US gallons = 0.159 m^3)
bcpd	barrels of condensate per day
bopd	barrels of oil per day
bpd	barrels per day
bwpd	barrels of water per day
CAPEX	capital expenditure
CI	corrosion inhibitor
CO_2	carbon dioxide
FPSO	Floating Production Storage and Offloading vessel
GOR	Gas to Oil Ratio
H_2S	hydrogen sulfide
"	inch = 2.54 cm
KHI	Kinetic Hydrate Inhibitor
Km	Kilometer (1 KM = 0.621 mile)
L	Liter (1 Liter = 0.264 Gallons)
LDHI	Low Dosage Hydrate Inhibitor
m	Meter (1 meter = 3.28 ft)
MEG	ethylene glycol
MeOH	methanol
MM	million
MMscfd	million standard cubic feet per day
mpy	mils per year (corrosion rate)
OPEX	operational expenditure
PI	paraffin inhibitor
ppm	parts per million
psig	pounds per square inch (gauge)
scf	standard cubic feet
stb	standard barrel (1 barrel = 0.159 m^3)
THI	Thermodynamic Hydrate Inhibitor