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Thermodynamics properties of methane-olefin mixtures under reservoir conditions

Vinicius H. Boschini*, Nara A. Policarpo, Nilo R. Kim, Paulo R. Ribeiro

Abstract

The work aims to study the properties of the methane-olefin mixture for application well control context. Tests were carried out using a PVT cell and different molar fractions of methane, pressures and temperatures.

Key words:

Drilling fluids, Methane, Olefin.

Introduction

The study of the properties of drilling fluids is fundamental for the control of wells during drilling, in order to avoid the occurrence of kicks or even blowouts. Drilling fluids have the role of ensuring the safety of drilling and one of its main functions is to maintain a hydrostatic pressure in the reservoir to ensure that the formation gases do not invade the well[1-3]. The present work provides studies of the properties of the methane-olefin mixtures for different gas molar fractions performed in a PVT cell under high pressure and high temperature.

Results and Discussion

The tests were conducted in a PVT cell by the Constant Composition Expansion (CCE) procedure, that consists of the expansion of fluid under constant temperature, through the application of constant pressure gradients. During the test, the pressure, volume, and temperature are recorded[2,3]. The tests were performed with different molar fractions (y) of methane in the mixture (10, 20, 30, and 40%), in the temperatures (T) of 20, 25, 40, 60, and 80°C, and pressures (P) up to 8000 psi. The tests were run in duplicate and the PVT results recorded were applied in mathematical equations to obtain the mixture properties such as bubble point (P_{sat}), specific mass (ρ), solubility (R_s), and oil formation volume factor (B_o). The results can be found in Chart 1 and Image 1.

Chart 1. Methane-Olefin mixture properties at saturation.

y(%)	T(°C)	P_{sat}(psi)	ρ(g/cm^3)	B_o(cm^3/cm^{3}std)
10	20	1339	0,717	1,103
	25	1375	0,713	1,109
	40	1452	0,700	1,129
	60	1507	0,685	1,155
	80	1591	0,681	1,161
20	20	3456	0,640	1,250
	25	3478	0,633	1,262
	40	3559	0,622	1,285
	60	3669	0,606	1,318
	80	3729	0,593	1,348
30	20	3487	0,645	1,256
	25	3522	0,641	1,265
	40	3601	0,630	1,286
	60	3693	0,616	1,317
	80	3805	0,599	1,353
40	20	5234	0,608	1,360
	25	5236	0,605	1,367
	40	5291	0,588	1,406
	60	5238	0,573	1,443
	80	5153	0,560	1,476

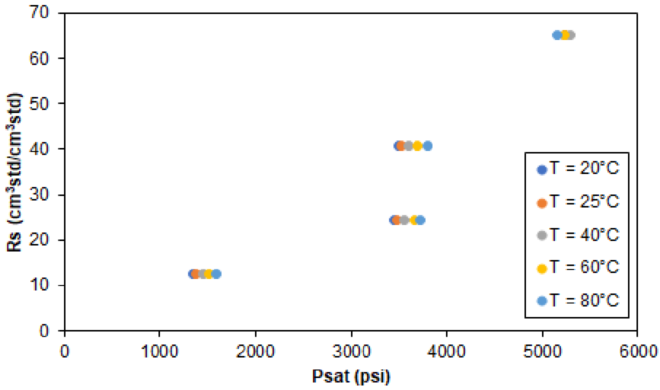

Image 1. Solubility of methane in olefin.

The specific mass of the mixture decreases as the temperature and pressure increase at saturation condition. The oil formation volume factor presents the opposite behavior, increases as the temperature and pressure increase. As expected, the saturation pressure rises with temperature and solubility as well[2,3]. Comparing the results obtained in the present work with previous ones carried out in the laboratory using another type of olefin[3] and n-paraffin[2] drilling base fluids (Chart 2), it may first be noted that the solubility of methane is lower in the present olefin, which shows good potential in the control of kicks.

Chart 2. Methane solubility (cm^{3}std/cm^{3}std) in different base drilling fluids.

y (%)	olefin (present work)	olefin[3]	n-paraffin[2]
10	12	42	48
20	24	65	144
30	41	98	149
40	65	-	230

Conclusions

It can be concluded that the olefin has an optimal application in the well control, and its performance testifies the usage as a base of drilling fluids.

Acknowledgement

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