7Y

STUDY OF HYDROCARBON MISCIBLE SOLVENT SLUG INJECTION PROCESS FOR IMPROVED RECOVERY OF HEAVY OIL FROM SCHRADER BLUFF POOL, MILNE POINT UNIT, ALASKA

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Total Project Cost:

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Contractor:	$119,720
Total	$319,720

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OBJECTIVES:

The ultimate objective of this three-year research project is to evaluate the performance of the hydrocarbon miscible solvent slug process and to assess the feasibility of this process for improving recovery of heavy oil from Schrader Bluff reservoir. This will be accomplished through measurement of PVT and fluid properties of Schrader Bluff oil, determination of phase behavior of Schrader Bluff oil solvent mixtures, asphaltene precipitation tests, slim tube displacement tests, core flood experiments and reservoir simulation studies. The expected results from this project include: determination of optimum hydrocarbon solvent composition suitable for hydrocarbon miscible solvent slug displacement process, optimum slug sizes of solvent needed, solvent recovery factor, solvent requirements, extent and timing of solvent recycle, displacement and sweep efficiency to be achieved and oil recovery.

SUMMARY OF TECHNICAL PROGRESS:

Work performed during this quarter includes preliminary reservoir fluid characterization and multiple contact test runs using EOS simulator. Reservoir fluid samples are being acquired from Conoco Inc., and the process is expected to continue through the next quarter. Also, the experimental apparatus for the displacement study was set up.

Reservoir Fluid Characterization:

Reservoir fluid characterization is one of the most important considerations in simulation of slim tube experiments and simulation of miscible flood performance in a reservoir. PVT simulator developed by Scientific Software-Intercomp is used in developing reservoir fluid characterization for Schrader Bluff crude. The PVT simulator is useful in simulating and/or matching laboratory PVT tests. Its regression capability allows determination of equation-of-state (EOS) parameter values which result in best agreement between calculated data and laboratory data. The EOS parameters determined from this simulator can be used as an input data for multidimensional compositional reservoir simulation models in future.

The PVT simulator is capable of simulating saturation pressure calculation, density, viscosity calculation, flash expansion and multiple contact calculations. The simulator will split out any plus fraction in hydrocarbon system into an automatically determined or specified number of extended fractions. The simulator can also be used to pseudoize the fluid sample into fewer components. Peng-Robinson equation-of-state is used in the fluid characterization of Schrader Bluff reservoir crude.

The Schrader Bluff reservoir crude consists of thirteen components, from C_1 to $C_{11}+$, N_2 and CO_2. These thirteen components are regrouped into ten components using two pseudocomponents. C_6 to C_8 is grouped into one pseudocomponent (PC_1) and C_9 to C_{10} is grouped into other pseudocomponents (PC_2). The grouping of these pseudocomponents is done on weight basis. Regression is repeated on the pseudoized system for optimal match with lab data.

Multiple Contact Test Runs:

The EOS parameters obtained from the regression on the pseudoized fluid system are used in conducting multiple contact tests using PVT simulator. Multiple contact tests were performed up to fifteen contacts. In Schrader Bluff reservoir, the produced gas from the reservoir is reinjected back into the Schrader Bluff formation. 90% of the gas is produced from Kuparuk formation and 10% is from Schrader Bluff formation. From the PVT analysis report of these two gases, their compositions are mixed in the ratio of 9:1 to obtain the injected gas (KUPSCH GAS) composition. The injection gas is enriched with different amounts of Natural Gas Liquids (NGL) in each multiple contact test run. The enrichment by NGL is varied from 0 to 45%. The multiple contact test runs were conducted for 0, 5, 15, 25, 35 and 45% of NGL enrichment with the lean gas.

Figures 1-3 are plotted from the results obtained from the multiple contact test runs. These figures are plotted for density versus number of contacts. For a miscible test run, the liquid and gas density versus number of contacts should converge, showing that the two fluids form one phase. From these figures, it is clear that these runs did not result in miscibility since the gas and liquid density lines do not converge. The liquid density decreases gradually due to the in situ mass transfer of intermediates from liquid phase to gas phase.

Figures 4-6 are plotted for equilibrium constants, K-values for different fractions (C_1, C_2, C_3, C_4, C_5, PC_1, PC_2 and $C_{11}+$) versus number of contacts. For a miscible test run, all lines representing each fraction in the K-value plots should converge to an equilibrium constant value of one. These K-plots also do not show achievement of miscibility since the lines do not converge to a value of one.

FUTURE WORK PLAN:

Core sample acquisition from Conoco Inc. will continue during the next quarter. Acquisition of field samples and materials is expected to be complete by the end of next quarter. Slim tube displacement experimental apparatus and the coreflood apparatus are being calibrated and are expected to be available during this quarter. GEM simulator developed by Computer Modelling Group will be used to simulate the slim tube displacement runs. PVT data gathering process will continue through the next quarter. A three-phase compositional simulator will be used to verify the results obtained using EOS simulator.

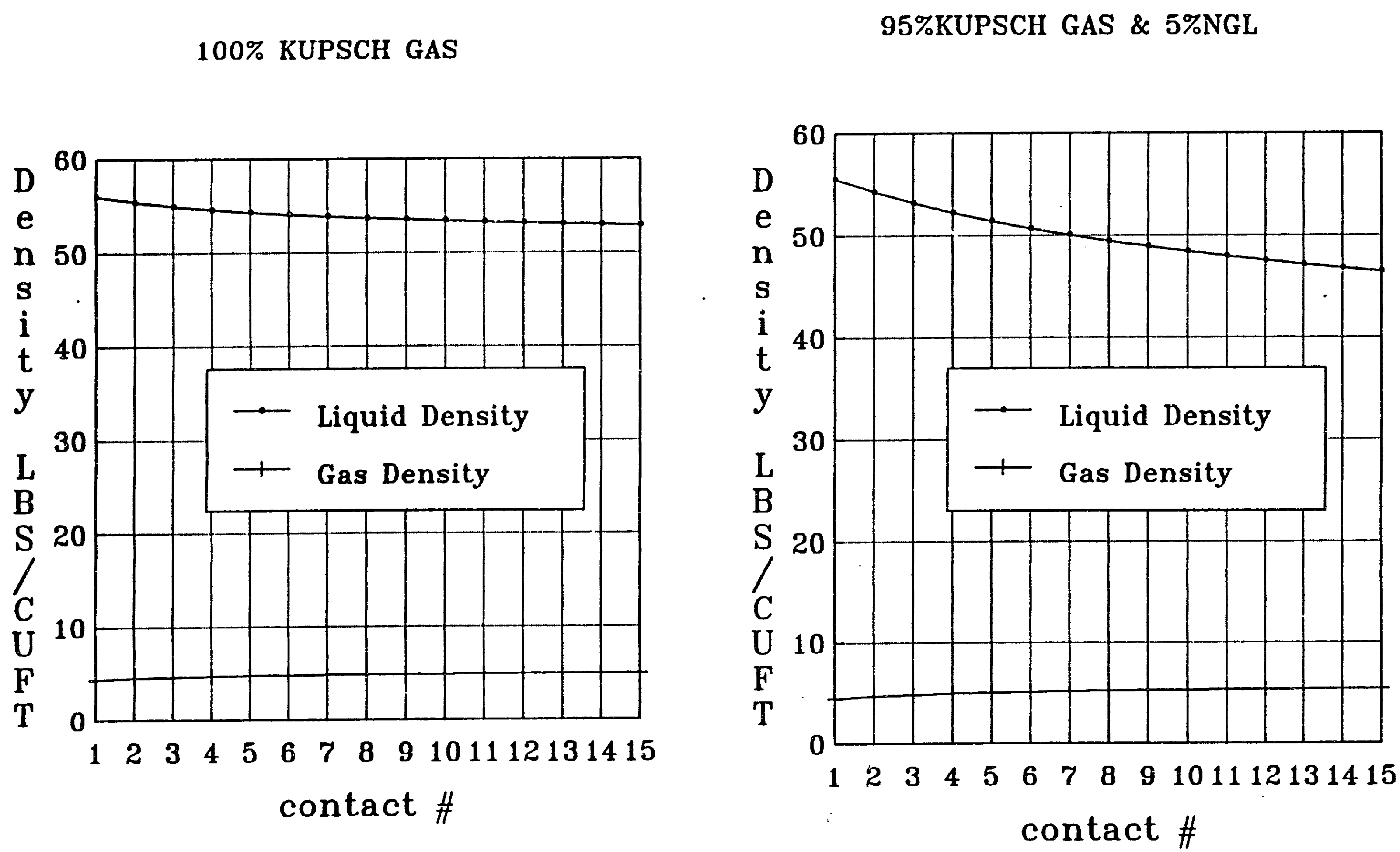


Fig 1. Density vs Contact Number

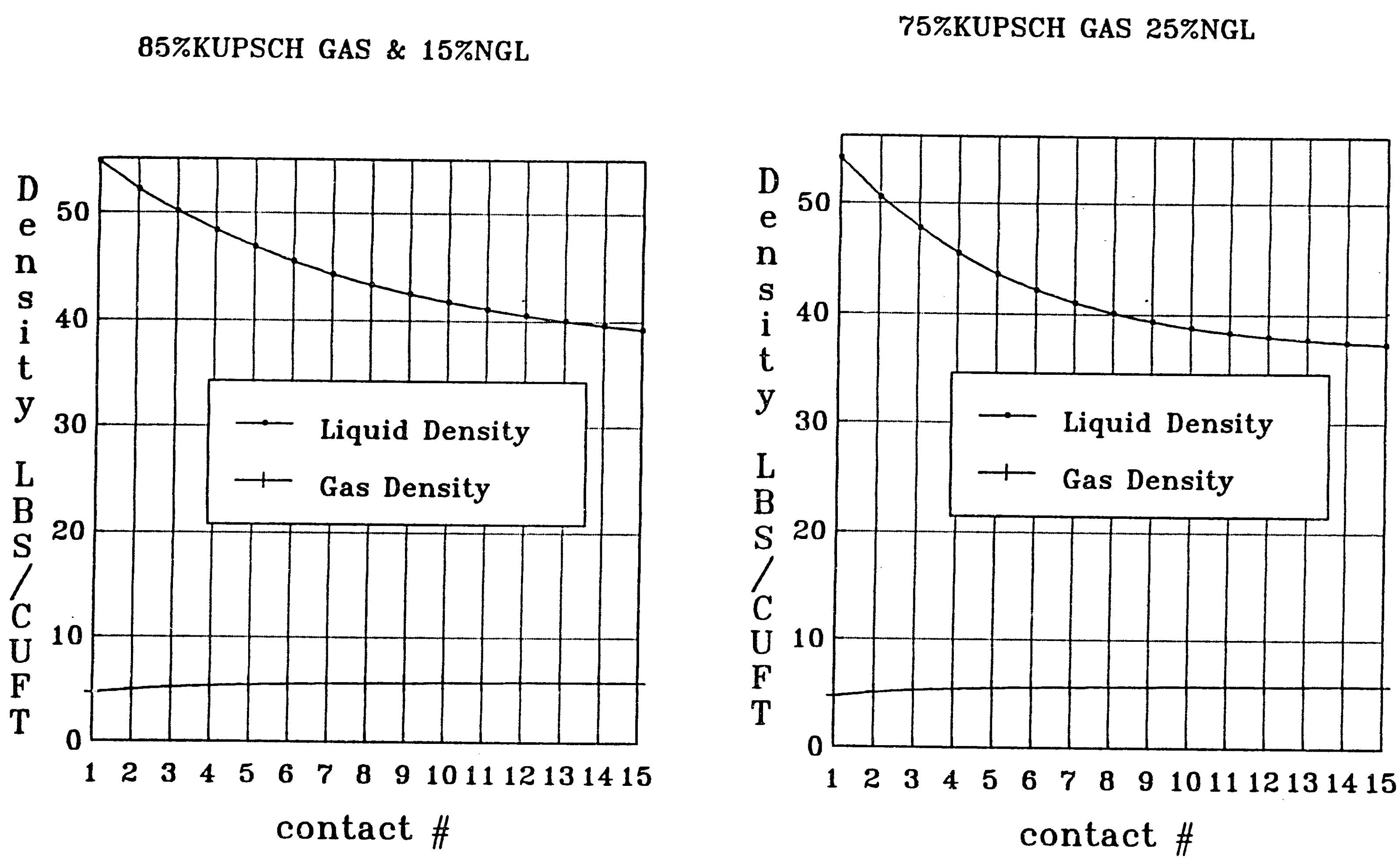


Fig 2. Density vs Contact Number

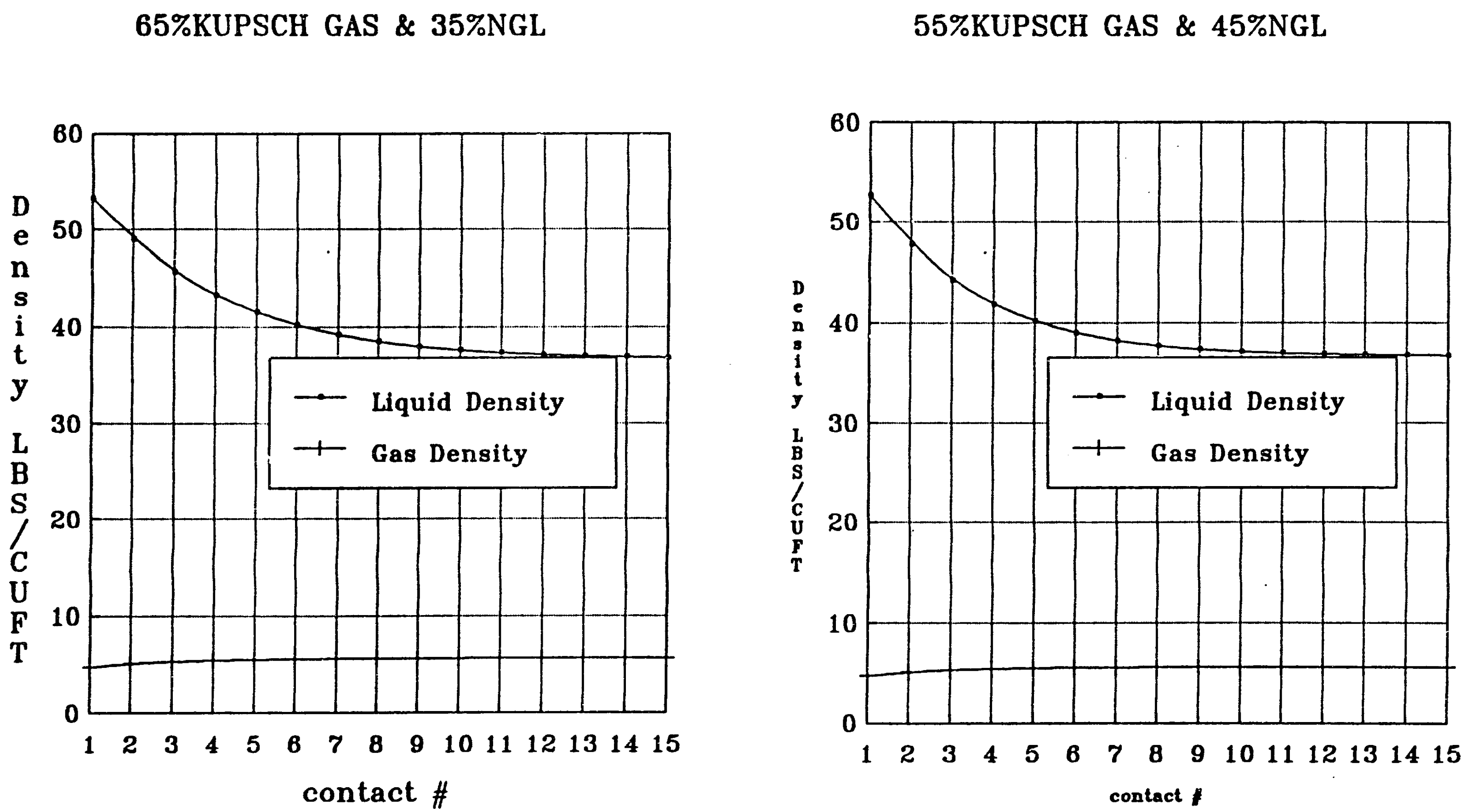
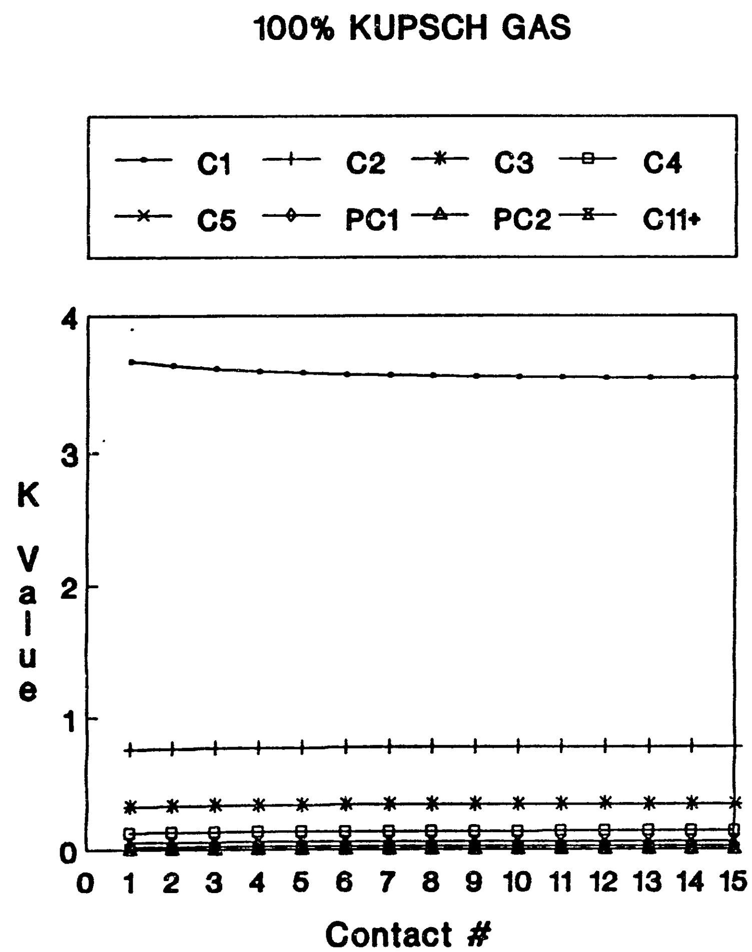


Fig 3. Density vs Contact Number



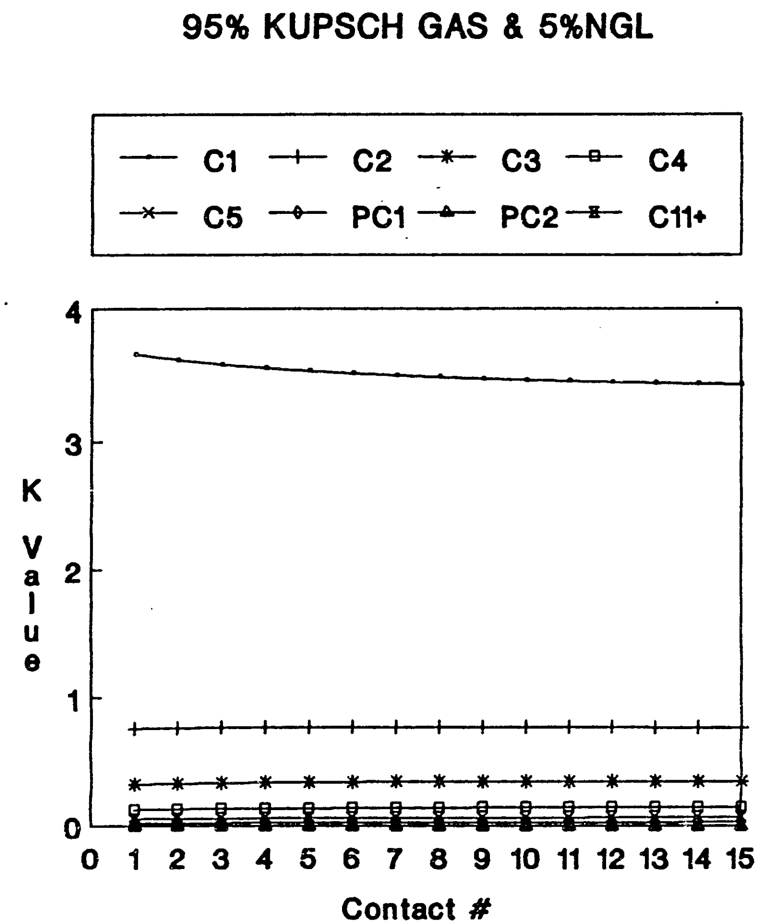


Fig 4. K–value vs Contact Number

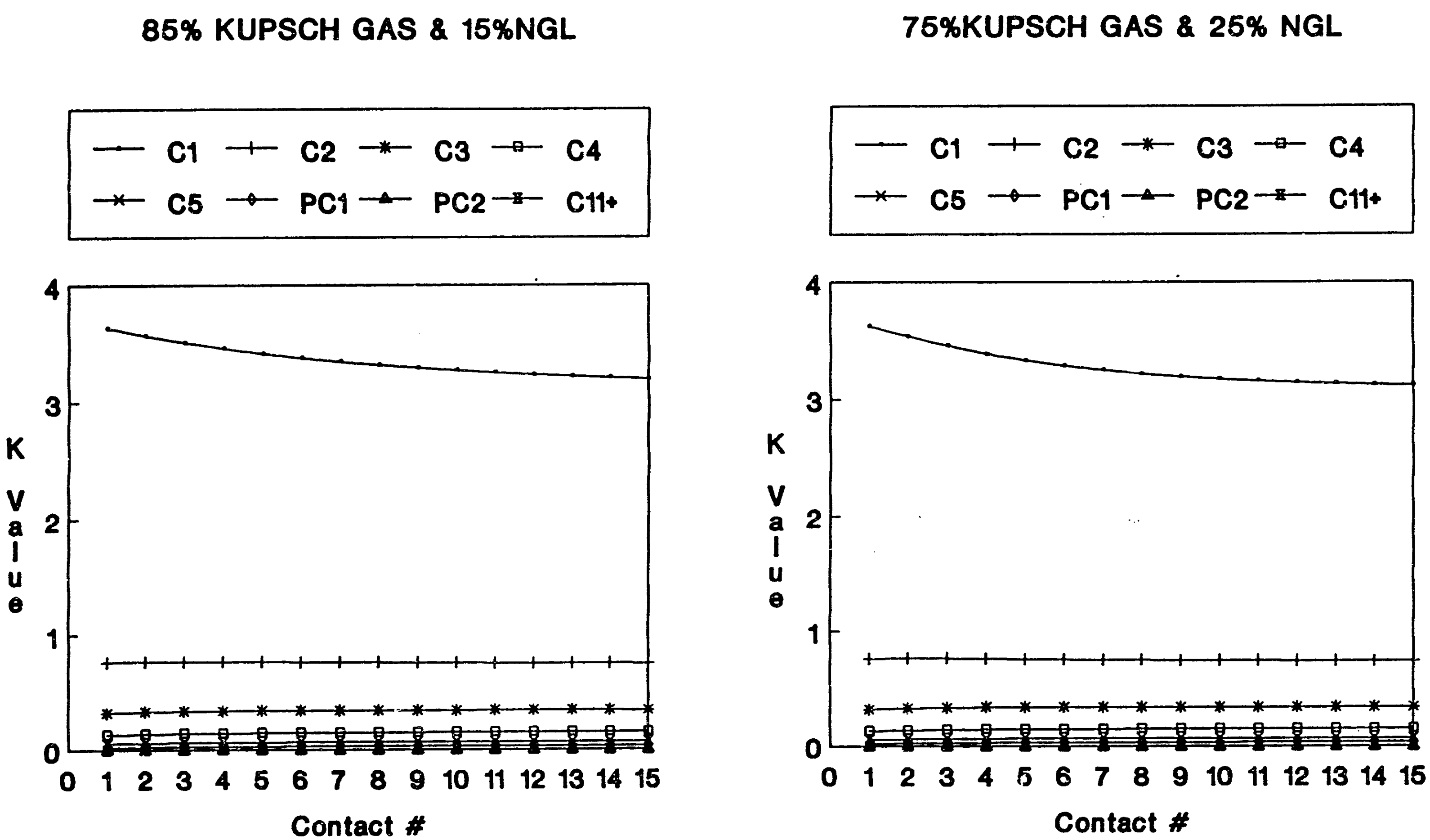


Fig 5. K–Value vs Contact Number

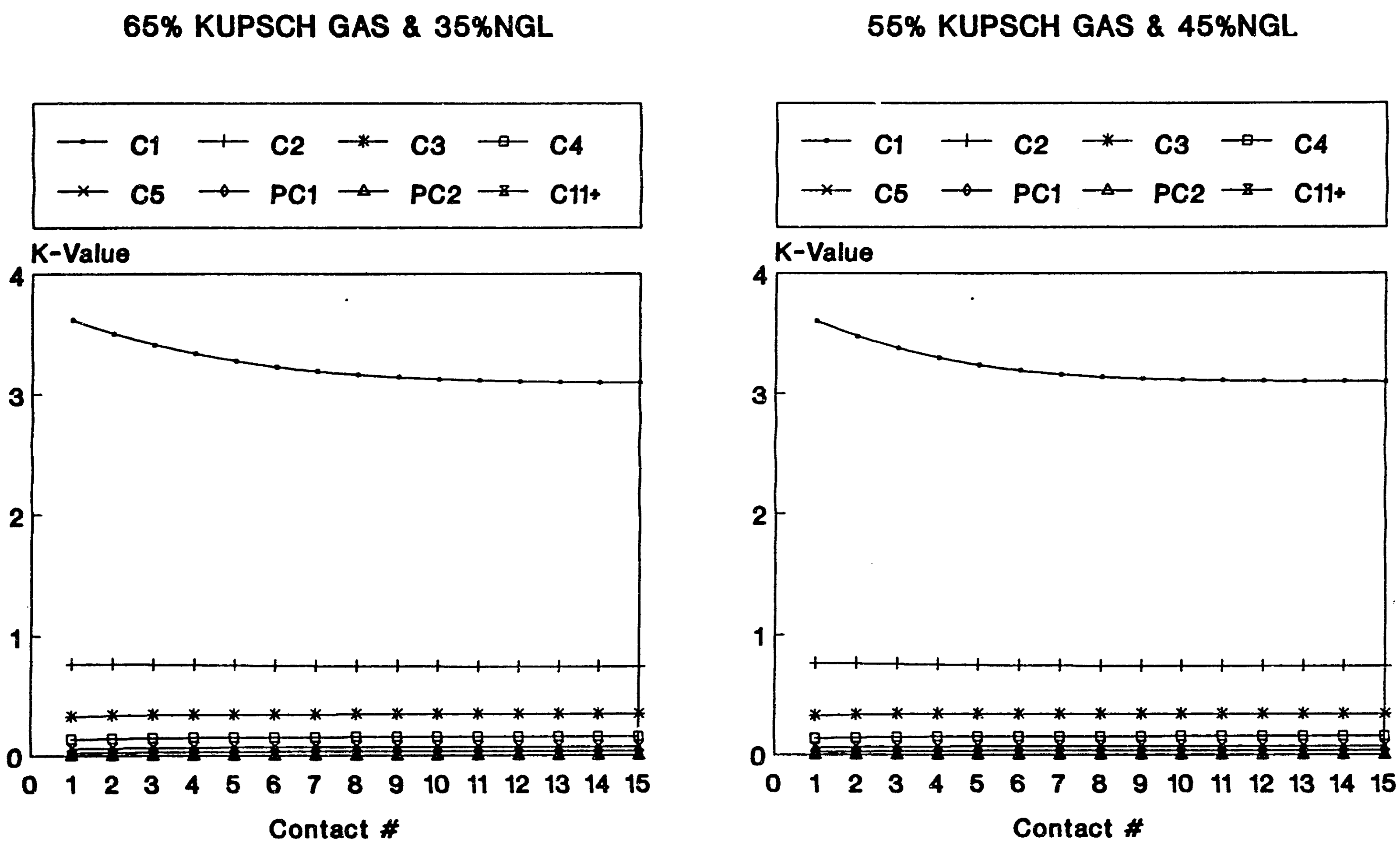


Fig 6. K–Value vs Contact Number

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