Model solvent/V-1072 비가 알래스카산 아역청탄의 액화 수율에 미치는 영향

Effect of model solvent/V-1072 ratio on the liquefaction yield of Alaskan subbituminous coal

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INTRODUCTION

Direct liquefaction can be regarded as two loosely defined consecutive steps : dissolution and upgrading. During dissolution, the cleavage of coal molecular structure consisting of aromatic clusters linked by aliphatic bridges and ether linkages leads to the liberation of radical fragments with a wide range of molecular weights. It has been well known that coal liquefaction efficiency is affected by qualities of feed solvent because solvent participates not only in physical dispersion of coal molecules but in chemical stabilization of thermally produced coal free radicals. Previous studies[1-4] have shown the importance of hydrogen donors and shuttling agents in coal liquefaction.

The purpose of this paper presented here is to describe some of findings which examine the liquefaction behavior of Alaskan subbituminous coal to determine which components of the solvent are most critical in the coal dissolution reaction.

EXPERIMENTAL

Materials

Coal from Usibelli in Alaska was used as a sample. The sample was ground to pass 150 mesh(0.105 mm) screen and stored in a nitrogen atmosphere. Thermal liquefaction runs at several residence times(10, 20 and 30 min.) were performed in a hydrogen atmosphere with varying model solvent/V-1072 ratio. V-1072 is the heavy hydrotreated distillate portion[5] of the recycle stream from Run 258 at Wilsonville Advanced Coal liquefaction Facility. Run 258 is a CC-ITSL test with Black Thunder subbituminous coal. Four kinds of model solvents, two hydroaromatics (tetralin and 9,10-dihydrophenanthrene) and two aromatics (naphthalene and phenanthrene) were added to V-1072 vehicle to see the hydrogen donation or shuttling effect upon liquefaction yields.

Procedure

All reactions were done in a shaking microautoclave system which has the capacity to simultaneously immerse three 30 ml microreactors into the preheated molten salt (KNO_3, 55.8 wt% ; $Ca(NO_3)_2$) bath. Prior to reaction, each microreactor was charged with 3g of coal and 6g of model solvent/V-1072 distillate with appropriate ratio, and pressurized to 950 psi with hydrogen at room temperature. After a given reaction reaction time, and after venting the gaseous products, the residual products remaining in the microreactor were thoroughly collected. Their solubilities in n-pentane, benzene and pyridine were then measured. The direct extraction technique described by Roberto and Cronauer[6] was used.

CONCLUSION

The effect of model solvent/V-1072 heavy hydrotreated recycle distillate - ratio on the liquefaction of Alaskan subbituminous coal has been described. Model solvents used were tetralin, 9,10-DHP, naphthalene and phenanthrene. The former two hydroaromatic solvents gave similar trends of nearly constant preasphaltene yield, steady decrease in asphaltene, meanwhile, a monotonic increase in oil yield with the increase of each solvent concentration was observed. The main difference between the two solvents was that coal conversion remained nearly constant with tetralin concentration, while a slight increasing trend in coal conversionwas observed with the increase of 9,10-DHP concentration. Both aromatic solvents of naphthalene and phenanthrene gave very similar trends in liquefaction product distribution. Asphaltene, preasphaltene and coal conversion showed monotonically decreasing trends, but the oil yield showed increase with aromatic solvent concentration. With added hydrogen donor, both coal conversion and oil yield increase with time. With added hydrogen shuttler, the transfer of hydrogen from coal to itself is enhanced, leading to higher yields of oil and pyridine insolubles.

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