

Rough Separation of Heterocyclic Nitrogen Compounds Contained in Coal Tar Absorption Oil Fraction

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Heterocyclic nitrogen compounds (quinoline, isoquinoline, indole, etc) in coal tar absorption oil fraction are useful as feed in agricultural chemicals and medicine, etc. However, the separation and refining process of these compounds are so complicated and difficult that a simpler method is needed.

The purpose of this study is to roughly separate heterocyclic nitrogen compounds from coal tar absorption oil fraction (in this study, heterocyclic nitrogen compounds were separated from other components without refining heterocyclic nitrogen compounds into each compound). First, liquid-liquid extraction method using methanol (aq) as solvent and emulsion liquid membrane method using water as membrane liquid were carried out in batch process and the effect of operating conditions on extraction equilibrium and mass transfer rate were studied. Then these two methods were compared.

In liquid-liquid extraction method, the separation resulted in high selectivity of nitrogen compounds and the composition of all components approached equilibrium in very short time. And in this method, the concentrations and yields of nitrogen compounds in the extract phase and the distribution coefficients of them were higher than aromatic hydrocarbons. But the distribution coefficients and yields were decreased with increase of mass fraction of water in extract phase. Separation selectivities were increased with increase of mass fraction of water in extract phase. Mass transfer coefficients were increased with increase in stirring velocity. And mass transfer coefficients of each component were almost identical.

In emulsion liquid membrane method,

although the concentration difference, which worked as driving force, still exists, permeations of nitrogen compounds were restrained. On the other hand, increasing stirring time increased permeations of aromatic hydrocarbons and oxygen heterocyclic compounds. When the stirring time was short, permeation coefficients of nitrogen compounds were 10 times larger than that of aromatic hydrocarbons. And the permeation coefficients of nitrogen compounds were decreased with increase of stirring time when compared to aromatic hydrocarbons. When the experimental values of separation selectivities of nitrogen compounds were compared with the theoretical one (ratio of distribution coefficients of nitrogen compounds to aromatic hydrogen compounds), it appeared that the experimental values were much smaller.

When these two separation methods were compared in the same condition (ratio of solvent to feed), yields of nitrogen compounds were identical and separation selectivities in liquid-liquid separation method were larger than that of emulsion liquid membrane method. Countercurrent multistage process was simulated using the experimental results of distribution, mass transfer and permeation coefficients. In the same operating condition, yields of nitrogen compounds in liquid-liquid extraction method approached 1 and the purities in this method were higher than emulsion liquid membrane method.

Consequently, heterocyclic nitrogen compounds in coal tar absorption oil fraction were selectively separated from other components.