

New Structure H Clathrate Hydrate Formers

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Hexamethyleneimine, 1-methylpiperidine, 2-methylpiperidine, 3-methylpiperidine and 4-methylpiperidine as isomers of C₆H₁₃N were revealed as new sH clathrate hydrate forming molecules. They show fully soluble characteristics to water whereas already known sH formers such as methylcyclohexane and 2, 2-dimethylbutane (neohexane) are immiscible or very slightly soluble to water. The L-H-V equilibrium P-T behavior of these new sH clathrate hydrates shows a tendency to shift to much milder condition than already known ones. We particularly note that 1-methylpiperidine appears to be the best for promotion. To verify the distribution of CH₄ molecules and crystal structure of clathrate hydrates, 600MHz solid-state NMR, Raman spectroscopy and XRD pattern analysis were conducted. These noticeable properties of new formers are expected to open new research fields to the hydrate community and contribute to hydrate-based technological applications with high energy efficiency.