industrial usages, especially for the application used under the freezing point of water.

4. Conclusion

The phase equilibrium conditions were measured for the systems of (HFC-32 + water) and (HFC-32 + methylpiperidine + water) within a temperature range of 259.3 to 272.2 K. The results indicate that the system with methylpiperidine had milder phase equilibrium conditions. The simple hydrate formed with only the HFC-32 is identified as the sI [8], however in this study the cage structure differed by adding the methylpiperidine as the LMGCs. The PXRD measurements were hold in order to determine the cage structures of formed hydrates. With the obtained results it can safely declared that the cage structure formed in present study was sH hydrates. Furthermore, the lattice constant of the hydrate formed with difluoromethane and N-methylpiperidine differed from that of the hydrate formed with methane and N-methylpiperidine. The geometric status of each molecular should be responsible of the difference. This study was able to conduct the basic research about the small cages and guest molecules encapsulated in the hydrate. For the further understanding, the studies on the guest molecules and the small cages could be done with more details.

Compared to the simple hydrate formed with difluoromethane and water, the decrease in equilibrium pressure was observed below 275 K which limits its possible applications. Considering the operation environment, it will be not suitable for the residential heat pump/refrigeration system however may be used for the different applications. Since the pressure conditions were mild, the technologies applied within low temperature range are preferable.

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