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Refrigerant mixtures as alternatives to
HCFC22 and R502:

Systematics + pinch point Studies

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Abstract

With the issue of phasing out of fully halogenated hydrocarbons (Chloro-Fluoro-Carbons, CFCs) for refrigeration applications being nearly settled, the global attention has turned towards the partly halogenated hydrocarbons (Hydro-Chloro-Fluoro-Carbons, HCFCs). At the Copenhagen Amendments (September 1992) to the Montreal Protocol, for the first time HCFCs were brought under the controlled substances, recommending their phase out by the year 2020 (down to 99.5%) and completely by 2030. At the Vienna Convention (December 1995), the phase out dates for the industrialised countries were not changed. However, for the Article 5 countries like India, the HCFC consumption has to be frozen with effect from 2016 at the levels of 2015, leading to a total phase out by the beginning of 2040. Countries of the EC have decided to phase out HCFCs at faster rates than those prescribed by Vienna Convention leading to a complete phase out by 2015.

The most affected working fluid by these decisions is HCFC22 which is widely used in airconditioning applications. In fact, the importance of HCFC22 was enhanced in recent years due to the CFC phase out because in chillers and in refrigeration, HCFC22 was substituted for CFC12 and R502. This means that, now in addition to replacements for HCFC22, one has to look for replacements for R502 also.

It has been well realised that look-alike or drop-in single component substitute working fluids for HCFC22 and R502 have not been identified so far. Eventhough refrigerants such as HFC134a, propane and ammonia have been suggested as possible replacements for HCFC22 for specific applications, these differ significantly in thermodynamic and thermophysical properties from HCFC22 thereby requiring major system design modifications. The situation is more grim in the case of R502.

Germany has led the way in imposing the phasing out of CFCs and HCFCs at dates earlier than those prescribed by the Protocol. For instance, phase out of HCFC22 for new plants will have to be effected by January 2000.

India, which is listed under the Article 5 Countries of the Montreal Protocol, has also shown total commitment to enforcing the phase out schedules. In early 1997, CFC free refrigerators are expected to be available in the Indian market. Manufacture of ozone friendly HFC134a compressors for refrigerators has been started by at least two industries. At the time of making this report, a major large size compressor manufacturer had reached final stages of plans to extend the range to R134a compressors. Serious considerations are being given to widening the use of ammonia. Other natural fluids, mainly hydrocarbons (iso-butane, propane, and their mixtures) are being seriously considered for domestic refrigerators. Many new installations have come up with HCFC 123 as replacement to CFC11.