



*Chapter - 4*  
**Conclusions**

## **4.0 Conclusions :-**

### **4.1 Summary and Conclusions :-**

Based on the results presented, following summary and conclusions have been drawn.

- 1. Synthesis of novel diimide-diacid (IV) through the condensation reaction of TPTPDA and TMA is successfully accomplished and monomer was characterised by elemental analysis, IR, NMR and Mass spectral techniques.**
- 2. Using direct amidation Yamazaki's method, diimide-diacid (IV) could be polymerised with various aromatic diamines to yield poly(amide - imide)s, co poly(amide - imide)s were also synthesized by employing various mol % of (IV) with oxybis(benzoicacid) and ODA / SDA, where in lithium chloride (8%) was used along with NMP – pyridine solvent system.**
- 3. Viscosity values in the range of 0.54 to 4.48 dL/g indicate formation of high molecular weight polymers. These polymers were pale yellow, fibrous and film forming, probably due to higher reactivity of ( IV ).**
- 4. Solubility of poly(amide - imide)s and copolymers was tested in different solvents. Most of the polymers under study dissolved in polar aprotic solvents viz. DMAc, NMP etc., copolymers had better solubility because of random, nonorder arrangement and less crystalline (i.e. more amorphous) nature. This has been attributed to the flexibility of the system caused by the increased mobility of the molecular segments when amorphous polymers interact with solvent. Incorporation of (IV) i.e. phenylated moiety increased**

the solubility remarkably. Thus the approach of incorporation of phenylated monomer (IV) and copolymerisation were synergistically more effective for improving the solubility of polymers in organic solvents.

5. X – ray diffraction pattern of polymers suggest that naphthalene based poly(amide - imide)s is semicrystalline in nature, where as ODA and SDA based copoly(amide - imide)s are amorphous. The above observations also support solubility properties of the polymers investigated.
6. The glass transition temperature of poly(amide - imide)s and copoly(amide - imide)s (250 to 340°C) depend on the aromatic content, ether / sulfone bridge, the extent of mol % of (IV) and on the structure symmetry of the reacting diamines / diacid, and flexibility of the resulting polymer chains.
7. Thermal stability of poly(amide - imide)s and copoly(amide - imide)s has been evaluated by dynamic thermogravimetric analysis under nitrogen atmosphere, and all polymers showed no weight loss below 405 °C.

A remarkable improvement in the overall thermal stability was observed for all poly(amide - imide)s and co poly(amide - imide)s as evidenced by no weight loss upto 405 °C. This is due to the considerable aromatic content and the class of poly(amide - imide)s. It was also observed that as the content of imide groups in copoly(amide - imide)s increased, the thermal stability of the copolymers along the series increased.

8. The novel phenylated diimide-diacid (IV) can be used as starting materials for the synthesis of processable poly(amide - imide)s, where by incorporation of pendant phenyl groups, imide and amide groups in a single molecular in order to combine their advantages to the resulting polymers, can be accomplished.

#### **4.2 Scope for further work : -**

The present dissertation, mainly dealt with synthesis, characterisation and properties of poly(amide - imide)s and copoly(amide - imide)s. There exists considerable scope for further studies on synthesis of other class of high performance polymers, such as poly(ester-imide)s, poly(amide-benzimidazole)s poly(amide-imide)s, poly(amide-imide-hydrazide)s, and poly(imide-quinoxaline)s etc. for use as high temperature coatings. Modification of these polymers would yield soluble and processable materials with good thermal stability.