CHAPTER V

CALORIMETRIC STUDIES

ABSTRACT

Differential Scanning Calorimetric studies elucidate valuable data about the phase transitions temperatures and thermal span of individual phase that are present in a mesogen. Further the enthalpy values obtained from the study of individual phase transitions gives information about the order of the transitions. This data can be used to interpret the occurrence of mono-tropic (phases that occur only in heating cycle) and enantiotropic (phases that occur only in heating and cooling cycle) phase transitions.
5.1 INTRODUCTION

Liquid crystals, when cooled from isotropic melt to lower temperature, passes through different mesomorphic phases [92]. The endothermic or exothermic energy with respect to temperature can be recorded using differential scanning calorimetric studies. Generally when the liquid crystal sample is cooled exothermic peaks are recorded, the area under the peaks gives the energy (J/g) possessed by the respective phase of the mesogen. Similarly when the liquid crystal is heated, endothermic peaks are observed. Thus from DSC studies, one can easily find the transition temperature precisely and the involved enthalpy values. A detailed observation of these enthalpy values in turn gives the order of the transition.

5.2 CRIMPING OF DSC CELL WITH LIQUID CRYSTAL COMPOUND

The aluminum cell with lid as described in Chapter 3, is filled with 3-5 gms of desired the liquid crystal compound and is mounted on a die of the crimpler. Care should be taken to see that edges of the cell should not stick out. After proper crimping, the cell is weighed and the exact weight of the compound is calculated. With forceps the filled crimped cell is placed in the DSC furnace unit.

5.3 CALORIMETRIC STUDIES OF 40. HOMOLOGUS SERIES

The compounds studied in this homologous series are 40.12 and 40.16. As already discussed in chapter 4, both 40.12 and 40.16 compounds
exhibit tri phase variance namely Nematic, Smectic A and Smectic B phases respectively.

5.3.1 DSC THERMOGRAM STUDIES OF 40.12 MESOGEN

The DSC thermograms of 40.12 mesogen is illustrated in Figure 5.1.

![Figure 5.1: Heating and cooling DSC endotherms of 40.12](image)

**Table 5.1** Transition temperatures and enthalpy values of 40.12 obtained in cooling run

<table>
<thead>
<tr>
<th>nO.m</th>
<th>Phase Transition</th>
<th>TM Temp. in °C</th>
<th>DSC Temp. in °C</th>
<th>ΔH (mJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.12</td>
<td>Isotropic - N</td>
<td>66.1± 0.01</td>
<td>66.16</td>
<td>1.47</td>
</tr>
<tr>
<td></td>
<td>N - Sm A</td>
<td>53.7± 0.01</td>
<td>53.99</td>
<td>not resolved well</td>
</tr>
<tr>
<td></td>
<td>Sm A-Sm B</td>
<td>52.6± 0.01</td>
<td>52.8</td>
<td>not resolved well</td>
</tr>
<tr>
<td></td>
<td>Sm B-Crystal</td>
<td>33.6± 0.01</td>
<td>33.73</td>
<td>55.2</td>
</tr>
</tbody>
</table>
From the DSC thermo gram of 4O.12 and Table 5.1 [104] the following observations are made

1) The heating cycle of the 4O.12 thermo gram gives information about the melt temperature 55°C where the crystal melts to liquid crystalline state. It may be noted that this temperature is quite different to that of the isotropic state.

2) In the cooling cycle of the thermogram, a peak at 66.6°C with an entropy value of 1.47 m/J is observed, which is attributed to the isotropic liquid to Nematic phase transition.

3) The transition from Nematic to smectic A phase is at 53.99°C. This transition is not well resolved in the DSC thermogram but identified in the thermal microscopic studies.

4) This transition is classified as second order transition because of the very less magnitude of the enthalpy value.

5) The smectic A transformed to smectic B phase at 52.8°C, however the DSC thermo gram for this transition is not well resolved. Basing on the microscopic textural studies this phase has been identified.

6) The smectic B transformed to crystal at 33.73°C with huge enthalpy value classifying it to be first order. A broad peak is observed in the DSC thermogram at 33.73°C manifesting the crystal formation.

7) The DSC studies of transition temperatures concurs with the thermal microscopic studies as can be seen from Table 5.1
5.3.2 DSC THERMOGRAM STUDIES OF 40.16 MESOGEN

The DSC thermograms of 40.16 mesogen is illustrated in Figure 5.2

![DSC thermogram for 40.16 mesogen](image)

**Figure 5.2: Heating and cooling DSC endotherms of 40.16**

**Table 5.2 Transition temperatures and enthalpy values of 40.16 obtained in cooling run**

<table>
<thead>
<tr>
<th>nO.m</th>
<th>Phase Transition</th>
<th>TM Temp. in °C</th>
<th>DSC Temp. in °C</th>
<th>ΔH (m/J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.16</td>
<td>Isotropic – N</td>
<td>63.15 ± 0.01</td>
<td>63.40</td>
<td>9.10</td>
</tr>
<tr>
<td></td>
<td>N- Sm A</td>
<td>61.55 ± 0.01</td>
<td>61.44</td>
<td>not resolved well</td>
</tr>
<tr>
<td></td>
<td>Sm A-Sm B</td>
<td>54.21 ± 0.01</td>
<td>54.15</td>
<td>2.81</td>
</tr>
<tr>
<td></td>
<td>Sm B-Crystal</td>
<td>50.16 ± 0.01</td>
<td>50.18</td>
<td>50.36</td>
</tr>
</tbody>
</table>
From the DSC thermo gram of 40.16 and Table 5.2 [104] the following observations are made

1) The heating cycle of the 40.16 thermo gram gives information about the melt temperature 65°C where the crystal melts to liquid crystalline state. It may be noted that this temperature is quite different to that of the isotropic state.

2) In the cooling cycle of the thermo gram at 63.4°C an anomaly with an enthalpy value of 2.81 m/J is observed, which is attributed to the isotropic liquid to Nematic phase transition.

3) The transition from Nematic to smectic A phase is at 61.44°C, an anomaly with an enthalpy value of 9.10 m/J is observed, which is attributed to the isotropic liquid to Nematic phase transition. This transition is not well resolved in the DSC thermogram but identified in the thermal microscopic studies.

4) This transition is classified as second order transition because of the very less magnitude of the enthalpy value.

5) The smectic A transformed to smectic B phase at 54.15°C, however the DSC thermo gram for this transition is not well resolved. Basing on the microscopic textural studies this phase has been identified.

6) The smectic B transformed to crystal at 50.18°C with huge enthalpy value of 50.36 m/J classifying it to be first order.

7) The DSC studies of transition temperatures concurs with the thermal microscopic studies as can be seen from Table 5.2
5.3.3 SALIENT FEATURES OF 4O. HOMOLOGOUS SERIES

From the systematic DSC studies of the 4O. homologous series, data obtained about the mesogenic thermal span and individual smectic phases are shown in Table 5.3

Table 5.3 Individual smectic phases and mesogenic thermal span of 4O. homologous series.

<table>
<thead>
<tr>
<th>nO.m</th>
<th>Thermal span in °C</th>
<th>Liquid crystalline thermal span in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Textural observation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nematic</td>
<td>Smectic A</td>
</tr>
<tr>
<td>40.12</td>
<td>12.17</td>
<td>1.19</td>
</tr>
<tr>
<td>40.16</td>
<td>1.96</td>
<td>7.29</td>
</tr>
</tbody>
</table>

From the Table 5.3 the following points are observed:

1) The thermal span of the Nematic phase in the entire series drastically decreased with the increment of carbon atoms in the alkyl chain.

2) However, the thermal span of smectic A is observed to increase as the chain length is increased.

3) The thermal span of the smectic B phase in the entire series drastically decreased with the increment of carbon atoms in the alkyl chain.

4) In the higher homologue compound namely 4O.16, Nematic and smectic B were quenched by around 10 °C and 15 °C respectively, while it is interesting to note that the smectic A has increased its thermal span around 8 °C.
5) On comparing both members of the 4O. series, it can be readily observed that the mesogenic thermal range has decreased by about 19°C.

5.4. DSC THERMOGRAM STUDIES OF 8O. HOMOLOGOUS SERIES

The compounds studied in this homologous series are 80.12 and 80.16. As already discussed in chapter 4, both 80.12 and 80.16 compounds exhibit di phase variance namely Smectic A and Smectic B phases respectively.

5.4.1 DSC THERMOGRAM STUDIES OF 80.12 MESOGEN

The DSC thermograms of 80.12 mesogen is illustrated in Figure 5.3

![DSC Thermogram](image)

**Figure 5.3: Heating and cooling DSC endotherms of 80.12**
Table 5.4 Transition temperatures and enthalpy values of 80.12 obtained in cooling run

<table>
<thead>
<tr>
<th>nO.m</th>
<th>Phase Transition</th>
<th>TM Temp. in °C</th>
<th>DSC Temp. in °C</th>
<th>ΔH (m/J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80.12</td>
<td>Isotropic – Sm A</td>
<td>76.1 ± 0.01</td>
<td>77.13</td>
<td>3.27</td>
</tr>
<tr>
<td></td>
<td>Sm A- Sm B</td>
<td>68.5 ± 0.01</td>
<td>68.73</td>
<td>3.54</td>
</tr>
<tr>
<td></td>
<td>Sm B- Crystal</td>
<td>37.1 ± 0.01</td>
<td>37.21</td>
<td>40.14</td>
</tr>
</tbody>
</table>

From the DSC thermo gram Figure 5.3 of 80.12 and Table 5.4 [104] the following observations are made

1) The heating cycle of the 80.12 thermo gram gives information about the melt temperature 75°C where the crystal melts to liquid crystalline state. It may be noted that this temperature is quite different to that of the isotropic state.

2) In the cooling cycle of the thermogram, a peak at 77.13°C with an enthalpy value of 3.27 m/J is observed, which is attributed to the isotropic liquid to Smectic A phase transition.

3) The transition from smectic A phase to smectic B phase is observed at 68.73°C with an enthalpy value of 3.54

4) This transition is classified as second order transition because of the very low magnitude of the enthalpy value.

5) The smectic B transformed to crystal at 37.21°C with huge enthalpy value of 40.14 m/J classifying it to be first order. A broad peak is
observed in the DSC thermogram at 37.21°C manifesting the crystal formation.

6) The present DSC studies of transition temperatures concurs with the thermal microscopic studies as can be seen from Table 5.3

**5.4.2 DSC THERMOGRAM STUDIES OF 80.16 MESOGEN**

The DSC thermograms of 80.16 mesogen is illustrated in Figure 5.4

![Graph showing DSC thermograms of 80.16 mesogen](image)

**Figure 5.4: Heating and cooling DSC endotherms of 80.16**
Table 5.5 Transition temperatures and enthalpy values of 80.16 obtained in cooling run

<table>
<thead>
<tr>
<th>n0.m</th>
<th>Phase Transition</th>
<th>TM Temp. in °C</th>
<th>DSC Temp. in °C</th>
<th>ΔH (m/J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80.16</td>
<td>Isotropic – Sm A</td>
<td>86.1 ± 0.01</td>
<td>85.70</td>
<td>5.96</td>
</tr>
<tr>
<td></td>
<td>Sm A- Sm B</td>
<td>65.9 ± 0.01</td>
<td>65.83</td>
<td>2.40</td>
</tr>
<tr>
<td></td>
<td>Sm B- Crystal</td>
<td>44.7 ± 0.01</td>
<td>43.68</td>
<td>63.58</td>
</tr>
</tbody>
</table>

From the DSC thermo gram Figure 5.4 of 80.16 and Table 5.5 [104] the following observations are made:

1) The heating cycle of the 80.16 thermo gram gives information about the melt temperature 68°C where the crystal melts to liquid crystalline state. It may be noted that this temperature is quite different to that of the isotropic state.

2) In the cooling cycle of the thermogram, a peak at 85.70°C with an enthalpy value of 5.96 m/J is observed, which is attributed to the isotropic liquid to Smectic A phase transition.

3) The transition from smectic A phase to smectic B phase is observed at 65.83°C with an enthalpy value of 2.40

4) This transition is classified as second order transition because of the very low magnitude of the enthalpy value.
5) The smectic B transformed to crystal at 43.68°C with huge enthalpy value of 63.58 m/J classifying it to be first order. A broad peak is observed in the DSC thermogram at 43.68°C manifesting the crystal formation.

6) The DSC studies of transition temperatures concurs with the thermal microscopic studies as can be seen from Table 5.4

5.4.3 SALIENT FEATURES OF 80. HOMOLOGOUS SERIES

From the systematic DSC studies of the 80. homologous series, data obtained about the mesogenic thermal span and individual smectic phases are shown in Table 5.6

Table 5.6 Individual smectic phases and mesogenic thermal span of 80. homologous series.

<table>
<thead>
<tr>
<th>nO.m</th>
<th>Thermal span in °C</th>
<th>Liquid crystalline thermal span in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Textural observation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smectic A</td>
<td>Smectic B</td>
</tr>
<tr>
<td>80.12</td>
<td>8.4</td>
<td>31.52</td>
</tr>
<tr>
<td>80.16</td>
<td>19.87</td>
<td>22.15</td>
</tr>
</tbody>
</table>
From the Table 5.6 the following points are observed:

1) The thermal span of the smectic B phase in the entire series decreased with the increment of carbon atoms in the alkyl chain.

2) However, the thermal span of smectic A is observed to increase as the chain length is increased.

3) In the higher homologue compound namely 8O.16, smectic B was quenched by around 10 °C while it is interesting to note that the smectic A has increased its thermal span around the same 10 °C.

4) On comparing both members of the 8O. series, it can be readily observed that the mesogenic thermal range has increased marginally by 2 °C.
5.5. DSC THERMOGRAM STUDIES OF 15O. HOMOLOGOUS SERIES

The compounds studied in this homologous series are 15O.8 and 15O.10, 15O.12 and 15O.16. As already detailed in Chapter 4, compounds 15O.8, 15O.10 and 15O.12 exhibit single phase variance namely Smectic F to Crystal while 15O.16 exhibit di phase variance namely Smectic F and Smectic G phases respectively.

5.5.1 DSC THERMOGRAM STUDIES OF 15O.8 MESOGEN

The DSC heating and cooling cycle for 15O.8 mesogen performed at a scan rate of 10°C/min is illustrated in Figure 5.5.

![DSC Thermogram of 15O.8 Mesogen](image)

**Figure 5.5 : Heating and cooling DSC endotherms of 15O.8**
Table 5.7 enumerates the transition temperatures obtained from DSC and thermal microscopy studies. Also the corresponding enthalpy values of 150.8 are given.

**Table 5.7 Transition temperatures and enthalpy values of 150.8 obtained in cooling run**

<table>
<thead>
<tr>
<th>nO.m</th>
<th>Phase Transition</th>
<th>TM Temp. in °C</th>
<th>DSC Temp. in °C</th>
<th>ΔH (m/J)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150.8</td>
<td>Isotropic – Sm F</td>
<td>82.5 ± 0.01</td>
<td>82.85</td>
<td>14.97</td>
</tr>
<tr>
<td></td>
<td>Sm F- Crystal</td>
<td>40.9 ± 0.01</td>
<td>40.03</td>
<td>45.53</td>
</tr>
</tbody>
</table>

From the DSC thermo gram of 150.8 and Table 5.7 [104] the following observations are made:

1) The heating cycle of the 150.8 thermogram gives information about the melt temperature 65°C where the crystal melts to liquid crystalline state. It may be noted that this temperature is quite different to that of the isotropic state.

2) In the cooling cycle of the thermogram, a peak at 82.85 °C with an entropy value of 14.97 m/J is observed, which is attributed to the isotropic liquid to smectic F phase transition.

3) This phase transition is classified as first order because of the high magnitude of the enthalpy value. In fact it is well known that transition from isotropic liquid to any liquid crystalline phase is reported to be first
order. Thus the present result is in concurrence of the reported literature.

4) At 40.03 °C a broad peak manifest the transition from smectic F phase to crystal with an enthalpy value of 45.53m/J.

5) This transition is classified as first order transition because of the high magnitude of the enthalpy value.

6) As expected the high enthalpy value is in accordance with the reported literature where transition from any liquid crystalline phase to crystal gives out high magnitude of enthalpy.

7) The DSC studies of transition temperatures concurs with the thermal microscopic studies as can be seen from Table 5.5
5.5.2 DSC THERMOGRAM STUDIES OF 15O.10 MESOGEN

DSC thermograms of 15O.10 mesogen is illustrated in Figure 5.6

![Diagram of DSC thermogram showing heating and cooling cycles for 15O.10 mesogen.]

Figure 5.6: Heating and cooling DSC endotherms of 15O.10

Table 5.8 enumerates the transition temperatures obtained from DSC and thermal microscopy studies. Also the corresponding enthalpy values of 15O.10 are given.
Table 5.8 Transition temperatures and enthalpy values of 15O.10 obtained in cooling run

<table>
<thead>
<tr>
<th>nO.m</th>
<th>Phase Transition</th>
<th>TM Temp. in °C</th>
<th>DSC Temp. in °C</th>
<th>ΔH (m/J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15O.10</td>
<td>Isotropic – Sm F</td>
<td>84.7 ± 0.01</td>
<td>83.15</td>
<td>35.09</td>
</tr>
<tr>
<td></td>
<td>Sm F- Crystal</td>
<td>44.3 ± 0.01</td>
<td>41.00</td>
<td>45.56</td>
</tr>
</tbody>
</table>

From the DSC thermo gram of 15O.10 and Table 5.8 [104] the following observations are made

1) The heating cycle of the 15O.10 thermogram gives information about the melt temperature 70°C where the crystal melts to liquid crystalline state. It may be noted that this temperature is quite different to that of the isotropic state.

2) In the cooling cycle of the thermogram, a peak at 83.15 °C with an enthalpy value of 35.09 m/J is observed, which is attributed to the isotropic liquid to smectic F phase transition.

3) This phase transition is classified as first order because of the high magnitude of the enthalpy value. In fact it is well known that transition from isotropic liquid to any liquid crystalline phase is reported to be first order. Thus the present result is in concurrence of the reported literature.
4) At 41°C a broad peak manifest the transition from smectic F phase to crystal with an enthalpy value of 45.56m/J.

5) This transition is classified as first order transition because of the high magnitude of the enthalpy value.

6) As expected the high enthalpy value is in accordance with the earlier member (150.8) of the 150. homologous series.

7) As the number of carbon atoms increases in the present homologous series the isotropic temperatures are increased along with the crystallization temperatures.

8) The DSC studies of transition temperatures concurs with the thermal microscopic studies as can be seen from Table 5.6
5.5.3 DSC THERMOGRAM STUDIES OF 150.12 MESOGEN

The DSC heating and cooling cycle for 150.12 mesogen performed at a scan rate of 10°C/min is illustrated in Figure 5.7.

![Diagram showing DSC heating and cooling cycles for 150.12 mesogen.](image)

**Figure 5.7 Heating and cooling DSC endotherms of 150.12**

Table 5.9 enumerates the transition temperatures obtained from DSC and thermal microscopy studies. Also the corresponding enthalpy values of 150.12 are given.
Table 5.9 Transition temperatures and enthalpy values of 15O.12 obtained in cooling run

<table>
<thead>
<tr>
<th>nO.m</th>
<th>Phase Transition</th>
<th>TM Temp. in °C</th>
<th>DSC Temp. in °C</th>
<th>ΔH (m/J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15O.12</td>
<td>Isotropic – Sm F</td>
<td>83.9 ± 0.01</td>
<td>83.67</td>
<td>35.62</td>
</tr>
<tr>
<td></td>
<td>Sm F- Crystal</td>
<td>44.1 ± 0.01</td>
<td>43.96</td>
<td>61.61</td>
</tr>
</tbody>
</table>

From the DSC thermo gram of 15O.12 and Table 5.9 [104,105] the following observations are made:

1) The heating cycle of the 15O.12 thermogram gives information about the melt temperature 75.4°C where the crystal melts to liquid crystalline state. It may be noted that this temperature is quite different to that of the isotropic state.

2) In the cooling cycle of the thermogram, a peak at 83.67 °C with an entropy value of 35.62 m/J is observed, which is attributed to the isotropic liquid to smectic F phase transition.

3) This phase transition is classified as first order because of the high magnitude of the enthalpy value. In fact it is well known that transition from isotropic liquid to any liquid crystalline phase is reported to be first order. Thus the present result is in concurrence of the reported literature.

4) At 43.96°C a broad peak manifest the transition from smectic F phase to crystal with an enthalpy value of 61.61m/J.
5) This transition is classified as first order transition because of the high magnitude of the enthalpy value.

6) As expected the high enthalpy value is in accordance with the earlier members (15O.8 and 15O.10) of the 15O. homologous series.

7) As the number of carbon atoms increases in the present homologous series the isotropic temperatures are increased along with the crystallization temperatures. Further the mesogenic thermal span decreases with the increment in the carbon chain length.

8) The DSC studies of transition temperatures concurs with the thermal microscopic studies as can be seen from Table 5.7
5.5.4 DSC THERMOGRAM STUDIES OF 15O.16 MESOGEN

The DSC heating and cooling cycle for 15O.16 mesogen performed at a scan rate of 10°C/min is illustrated in figure 5.8.

![DSC thermogram](image)

Figure 5.8: Heating and cooling DSC endotherms of 15O.16

Table 5.10 enumerates the transition temperatures obtained from DSC and thermal microscopy studies. Also the corresponding enthalpy values of 15O.12 are given.
Table 5.10 Transition temperatures and enthalpy values of 150.16 obtained in cooling run

<table>
<thead>
<tr>
<th>nO.m</th>
<th>Phase Transition</th>
<th>TM Temp. in °C</th>
<th>DSC Temp. in °C</th>
<th>ΔH (m/J)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150.16</td>
<td>Isotropic – Sm F</td>
<td>91.2 ± 0.01</td>
<td>91.00</td>
<td>19.05</td>
</tr>
<tr>
<td></td>
<td>Sm F - Sm G</td>
<td>87.3 ± 0.01</td>
<td>87.13</td>
<td>21.67</td>
</tr>
<tr>
<td></td>
<td>Sm G - Crystal</td>
<td>65.9 ± 0.01</td>
<td>65.87</td>
<td>51.67</td>
</tr>
</tbody>
</table>

From the DSC thermo gram of 150.16 and Table 5.10 [104] the following observations are made

1) The heating cycle of the 150.16 thermogram gives information about the melt temperature 68°C where the crystal melts to liquid crystalline state, smectic G, smectic F and isotropic phases at 79, 91 and 92 °C respectively.

2) In the cooling cycle of the thermogram, a peak at 91.0 °C with an enthalpy value of 19.05 m/J is observed, which is attributed to the isotropic liquid to smectic F phase transition.

3) This phase transition is classified as first order because of the high magnitude of the enthalpy value. In fact it is well known that transition from isotropic liquid to any liquid crystalline phase is reported to be first order. Thus the present result is in concurrence of the reported literature.
4) The phase transition from smectic F to smectic G is observed at 87.13°C with an enthalpy value of 21.67m/J which classifies it as a first order phase transition.

5) At 65.87°C a broad peak manifests the transition from smectic G phase to crystal with an enthalpy value of 51.67m/J.

6) This transition is classified as first order transition because of the high magnitude of the enthalpy value.

7) As expected the high enthalpy value is in accordance with the earlier members (150.8, 150.10 and 150.12) of the 150. homologous series.

8) As the number of carbon atoms increases in the present homologous series the isotropic temperatures are increased along with the crystallization temperatures. Further the mesogenic thermal span decreases with the increment in the carbon chain length.

9) The DSC studies of transition temperatures concurs with the thermal microscopic studies as can be seen from Table 5.8
5.6 SALIENT FEATURES OF 15O. HOMOLOGOUS SERIES

From the systematic DSC studies of the 15O. homologous series, data obtained about the mesogenic thermal span and individual smectic phases are shown in Table 5.11

**Table 5.11: Individual smectic phases and mesogenic thermal span of 15O. homologous series.**

<table>
<thead>
<tr>
<th>nO.m</th>
<th>Thermal span in °C</th>
<th>Liquid crystalline thermal span in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Textural observation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Smectic F</td>
<td>Smectic G</td>
</tr>
<tr>
<td>150.8</td>
<td>42.82</td>
<td>-</td>
</tr>
<tr>
<td>150.10</td>
<td>42.15</td>
<td>-</td>
</tr>
<tr>
<td>150.12</td>
<td>39.71</td>
<td>-</td>
</tr>
<tr>
<td>150.16</td>
<td>3.87</td>
<td>21.26</td>
</tr>
</tbody>
</table>

From Table 5.11 the following points are observed

1) The thermal span of the smectic F phase in the entire series decreased with the increment of carbon atoms in the alkyl chain.

2) In line with the previous result the thermal span of smectic F is also observed to decrease as the chain length is increased.

3) As the chain length increases, the mono phase variance of the present 15O. series becomes di variance as can be seen from the Table 5.9.
4) In the higher homologue compound namely 150.16, smectic F was quenched and in its place a new higher order mesophase viz., smectic G has been observed.

5) The above mentioned result is in concurrence with the previously published nO.m literature on other homologous series.