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first thermotropic liquid crystalline polymer that was a co-polyester of poly(ethylene terephthalate) (PET) and p-hydroxybenzoic acid (PHB). Commercialized were several thermotropic aromatic polyester liquid crystalline polymers. In the 1990's, a number of moldable liquid crystalline materials is now available in the market, i.e. the Vectra series from Hoechst Celanese. The study of liquid crystal (LC) properties in polymer systems holds out much promise for the future, not only because such systems will provide us with new knowledge about both polymers and liquid crystals, but also from the study of liquid crystals in biological systems.

## 2. Classification of Liquid Crystalline Systems.

In order to understand the structure and properties of polymeric liquid crystals it is essential to describe and define. The structure of thermotropic liquid-crystal polymer fibers varies depending on the raw material polymer and fiber manufacturing conditions but generally is a highly oriented fibrillar structure. With HBA/HNA fiber, macrofibrils having a size of about 5  $\mu\text{m}$ , fibrils having a size of about 0.5  $\mu\text{m}$  and microfibrils having a size of about 0.05  $\mu\text{m}$ , together with a very thin skin layer having a thickness of about 1  $\mu\text{m}$  have been observed.<sup>27</sup> Donald et al. observed a banded structure in polarized light, with the striations lying in the plane of the fiber. Xiao and Takahashi pointed out that while the arrangement of HBA and HNA in the molecular chain does not change, the a-axis and b-axis X-ray data do change, which suggests that sequences rich in HBA may have aggregated.<sup>28</sup>

Yang and Krigbaum Liquid Crystalline Polymers: Theories, Experiments and Nematodynamic Simulations of Shearing Flows. Hongyan Chen, Leonov A.I. [leonov@uakron.edu](mailto:leonov@uakron.edu) Department of Polymer Engineering, The University of Akron. Akron, Ohio 44325-0301.

Processing of bioorganic foods (biopolymers) must be done based on the properties containing them lyotropic liquid crystals. More than thirty years of research on liquid crystalline polymers (LCP) resulted in a huge amount of publications on physics, constitutive modeling and experimental results, which are briefly reviewed in this article. To date, some theories have been developed for the specific example of liquid crystals; thermotropic properties; chemical compound concentrations; and the effects of temperature on color changes of thermotropic displays (MST Learning Standard 4); learn how chemicals and energy combine to form a reaction (MST Learning Standard 4); learn how technological systems function (MST Learning Standard 5); learn how mathematics, science, and technology interact (MST Learning Standard 5).

### Period 1: Focus Discussion on the Problem Context.

Even though liquid crystals are all around us, students typically do not identify them as such. When there are just a few particles, it is difficult to distinguish between heterogeneous and homogeneous mixtures. KSB 2: MATTER.