B.Sc. Semester-VI
Organic Chemistry
Paper-XIV

2. Synthetic Polymers

Coverage:

14. (i) Thermoplastic Polymers
(ii) Thermosetting Polymers

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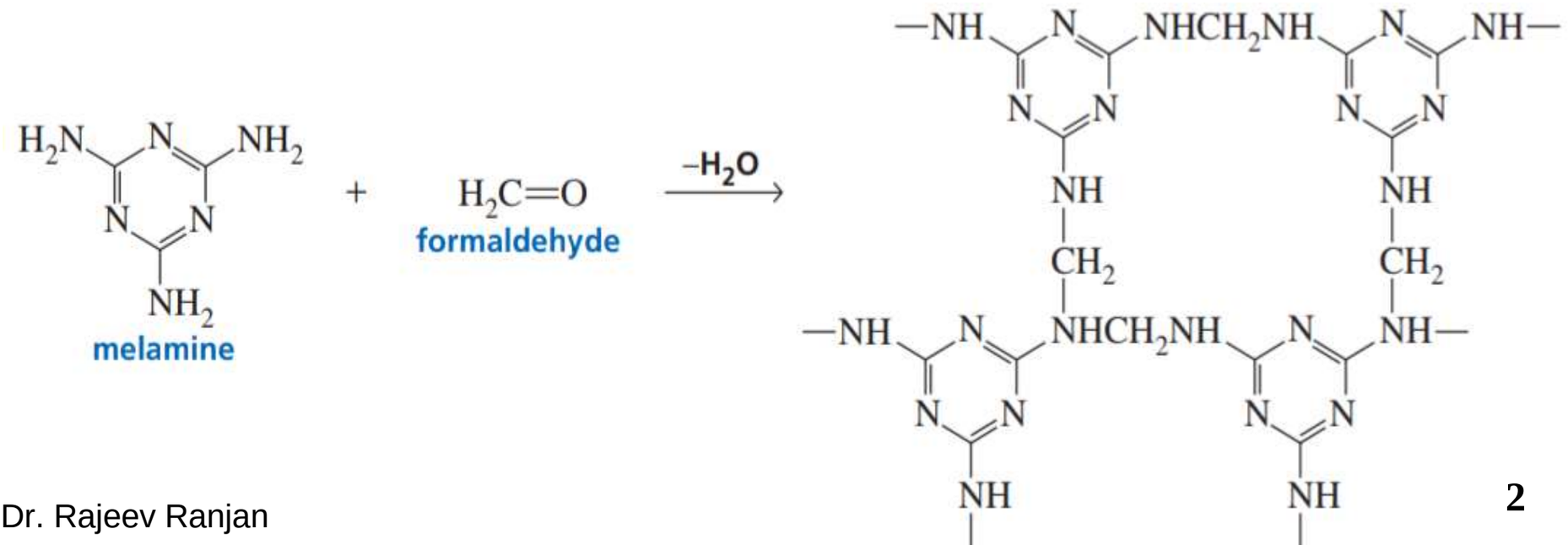
14. (i) Thermoplastic Polymers

Plastics can be classified according to the physical properties imparted to them by the way in which their individual chains are arranged. **Thermoplastic polymers** have both ordered crystalline regions and amorphous noncrystalline regions. Thermoplastic polymers are hard at room temperature, but soft enough to be molded when heated, because the individual chains can slip past one another at elevated temperatures. Thermoplastic polymers are the plastics we encounter most often in our daily lives—in combs, toys, switch plates, and telephone casings, for example. They are the plastics that are easily cracked.

14. (ii) Thermosetting Polymers

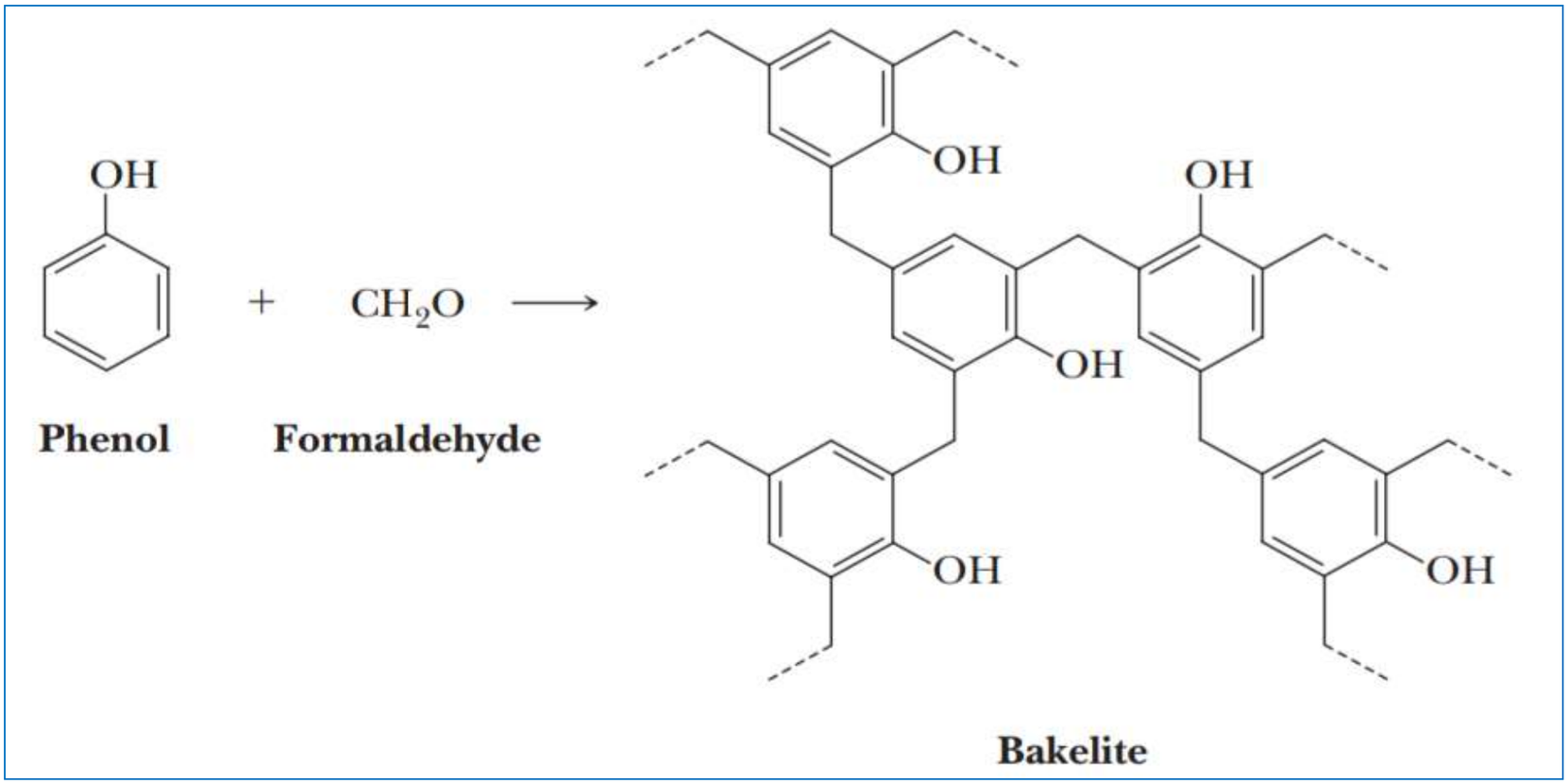
Very strong and rigid materials can be obtained if polymer chains are cross-linked. The greater the degree of cross-linking, the more rigid is the polymer. Such cross-linked polymers are called **thermosetting polymers**. After they are hardened, they cannot be remelted by heating, because the cross-links are covalent bonds, not intermolecular van der Waals forces. Cross-linking reduces the mobility of the polymer chains, causing the polymer to be relatively brittle. Because thermosetting polymers do not have the wide range of properties characteristic of thermoplastic polymers, they are less widely used.

Melmac®, a highly cross-linked thermosetting polymer of melamine and formaldehyde, is a hard, moisture-resistant material. Because it is colorless, Melmac® can be made into materials with pastel colors. It is used to make lightweight dishes and counter surfaces.

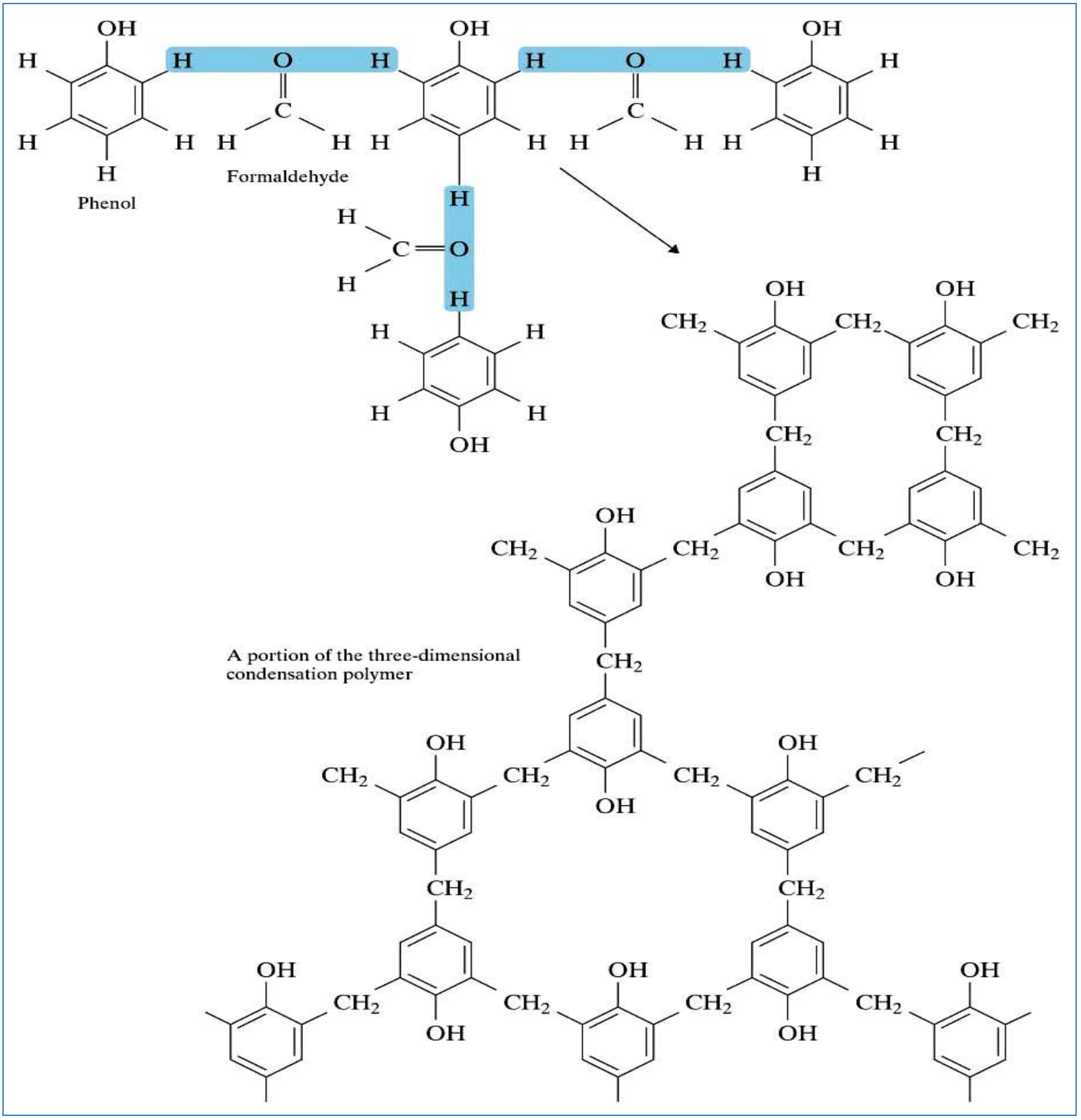


Bakelite

Thermosetting polymers are composed of long chains that are cross linked by covalent bonds. In effect, a thermosetting polymer is one giant molecule. The first thermosetting polymer was produced by Leo Baekeland (1863–1944) in 1907 by reacting phenol with formaldehyde to form the following three-dimensional structure. The product, known as Bakelite, is a good electrical insulator.



Bakelite is a condensation copolymer. It is formed by combining phenol and formaldehyde. A molecule of water is lost for each monomer that is added. Bakelite is a hard, sturdy material that is resistant to heat and electricity. Phenolic resins like bakelite have a wide range of uses.


Phenol
Formaldehyde
A portion of the three-dimensional condensation polymer