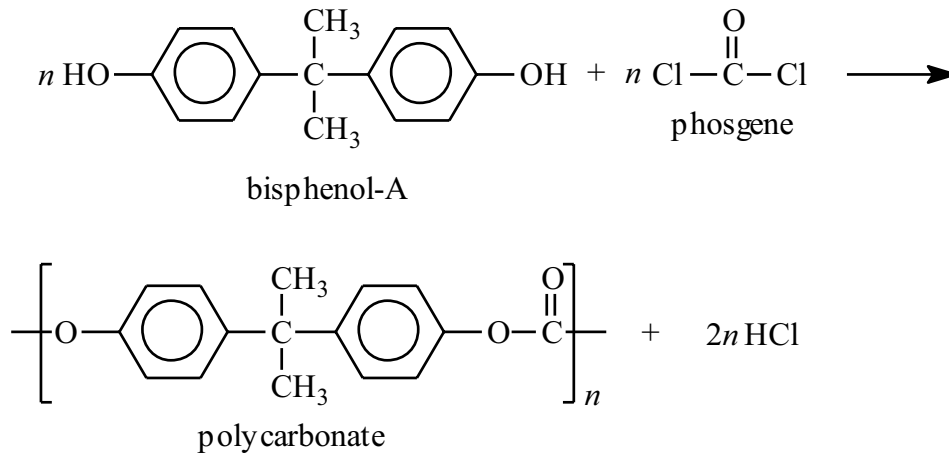


### 10.1.3 Polycarbonates

The polycarbonate obtained from bisphenol-A is the engineering thermoplastic with the second-highest sales volume. Polycarbonate (PC) is an amorphous polymer with attractive engineering properties (see Table 10-1), including high impact strength, low moisture absorption, low combustibility, good dimensional stability, and high light transmittance (up to 88%). The latter property has resulted in the application of PC as an impact-resistant substitute for window glass. Another important application for PC is its use as the material for compact discs. Among the disadvantages of PC are its limited chemical and scratch resistance and a tendency to yellow with long-term ultraviolet exposure. These problems have been addressed by the introduction of silicone-coated and free-radical stabilized polycarbonate resins.

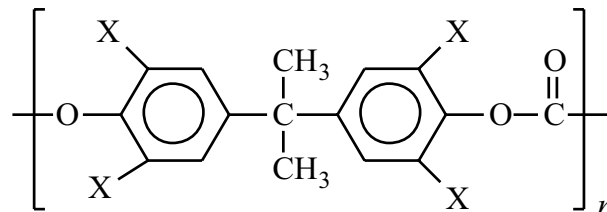
Polycarbonate can be synthesized by the polycondensation of bisphenol-A and phosgene, as shown in Figure 10-3. For each repeating unit that is formed, two molecules of hydrogen chloride are liberated. Alternatively, if the *sodium salt* of bisphenol-A is used in the polymerization, the by-product becomes sodium chloride rather than hydrogen chloride. This is an obvious advantage because the salt will precipitate out of the organic solvent used in the polymerization and, therefore, can

be easily and safely removed. In contrast, the production of strongly acidic hydrogen chloride requires special consideration for disposal and in the selection of construction material used in the polymerization reactor.



**Figure 10-3** Synthesis of bisphenol-A polycarbonate by the polycondensation of bisphenol-A and phosgene.

Other polycarbonates can be polymerized by modified interfacial condensation or by melt transesterification of tetrasubstituted bisphenols. These polycarbonates have the general structure



where X represents a halogen, especially bromine, or a methyl group. One example is tetramethylbisphenol-A polycarbonate (TMPC), X = CH<sub>3</sub>, which has a higher heat-distortion temperature (HDT) and better hydrolytic stability than PC. The HDT or  $T_g$  is a result of the greater rigidity of the TMPC chain due to the steric hindrance of the substituent methyl groups. One disadvantage of TMPC is its low impact resistance; however, this may be improved through blending with impact-resistant resins such as HIPS, ABS, and MBS (see Section 7.2.2). The styrene component of these impact modifiers forms a homogeneous phase with TMPC. Impact-modified grades of TMPC can also be used to increase the HDT of PVC. Tetrabromobisphenol-A polycarbonate (TMBPC), X = Br, can be blended with PC to increase HDT. Copolymers of bisphenol-A and tetrabromobisphenol-A or tetrachlorobisphenol-A provide better flame retardancy. The polycarbonate obtained from cyclohexanonebisphenol can be blended with PC to increase the HDT from 160° to 205°C.