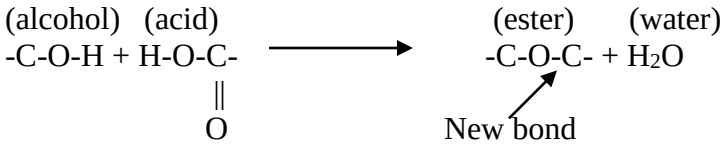
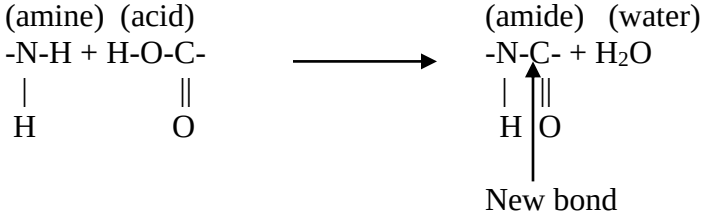
Step-growth polymerization forms polymers in a manner that is quite different from chain-growth polymerization. The mechanism requires that at least two different monomers participate in the reaction.[1] Before we consider the specific steps in step-growth polymerization, we'll first consider the necessary functional groups required in the monomers for the reaction(s) to occur.

Each stage in step-growth polymerization involves a reaction between dissimilar chemical groups which are part of the monomer molecules.[2] The chemical groups are termed "functional groups" due to the fact they provide a specific attribute (functionality) that allows them to react together in a specific way to give the desired resin properties.

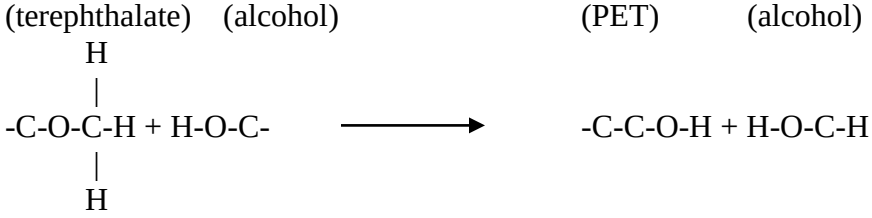
The most common type of reaction in forming resin via step-growth polymerization involves the formation of a new bond (covalent bond) between the two functional groups. Simultaneously, a by-product is produced from the reaction (sometimes water – which is why this polymerization is sometimes termed condensation polymerization). Let's illustrate this by looking at a generic alcohol and acid:



Two other types of monomers that combine via step-growth polymerization are an amine and an acid to form an amide:



Water is not the only by-product that might be produced, however. Here's an example of a step-growth polymerization where an alcohol by-product is produced:



A particular step-growth polymerization reaction of great historical and commercial significance is the polymerization of nylon. This reaction uses two symmetric bifunctional monomers (hexamethylene diamine and adipic acid). The resulting material is a polyamide, commonly known as nylon 6,6; the numerical designation in the name represents the number of carbons in each monomer.

Typical resins polymerized via step-growth include: acetals, nylons, polycarbonate, and polyesters.

Our next discussions will involve specific resins and how they perform both physically and mechanically. The resins to be presented have all been formed via the step-growth or chain-growth polymerization method; which in turn will have an effect on its strengths and weaknesses.

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[1] Askeland, Donald R., *The Science and Engineering of Materials*, PWS Publishing Company, 1994.
[2] Strong, A. Brent, *Plastics: Materials and Processing*, Prentice Hall, 2000.