

THERMOPLASTIC AND THERMOSET MATERIALS & MANUFACTURING

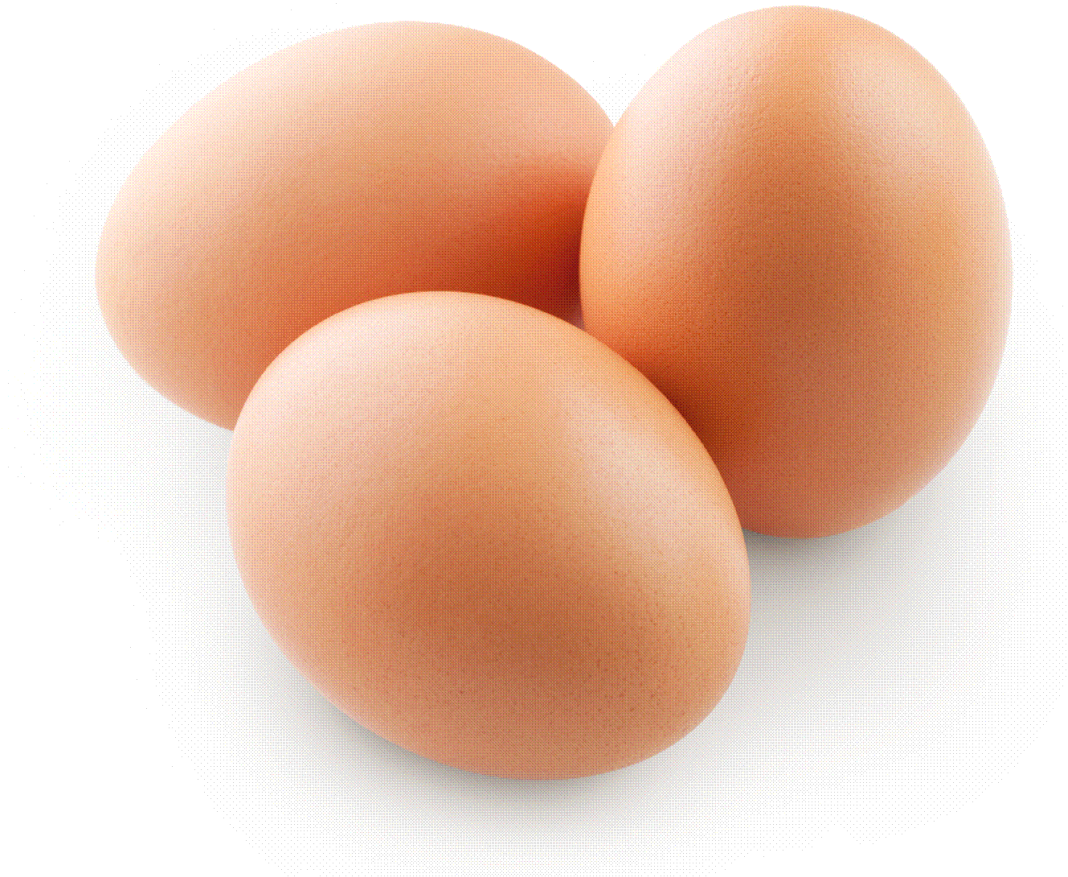
The terms Thermoplastic and Thermoset are used to describe the different types of plastic materials.

Thermoplastics can be melted and shaped several times. Think of thi



s in terms of a **candle wax** or **butter**. Butter and wax can be heated, liquefied, formed, and reformed as many times as you like.

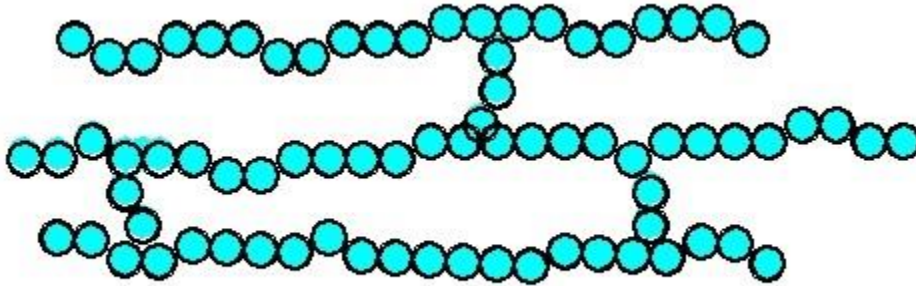
Thermosets allows only one chance to liquefy and shape it. Think of this in



terms of a **hardboiled egg**. It can be liquefied only once. After heat is applied the egg transforms from a liquid to a solid. Once the egg becomes a solid, it can never be returned to a liquid and re-formed.

The main difference between thermoplastics and thermosets is whether the polymer chains remain **linear** and **separate** after molding or whether they undergo a **chemical change** and form a network by **cross-linking**.

A cross linked material is thermoset and cannot be reshaped. Due to recent advances in polymer chemistry, the exceptions to this rule are growing.



SOME CROSS-LINKING MAY OCCUR IN THERMOPLASTICS

These exceptional materials are cross-linked thermoplastics. The cross linking can occur in the processing of the resin or in the annealing cycle. Remember that cross linking can be initiated by: Heat, chemical agents (like catalysts), irradiation, or a combination of these. Generally, cross-linked materials (Thermosets) demonstrate better properties, such as: Improved resistance to heat, less creep, and better chemical resistance.

However, thermosets will generally require a more complex process to produce a part, rod, sheet or tube. *There is always a tradeoff.* There will normally be a tradeoff as physical properties are changed, enhanced or diminished. Purposefully changing one physical property may also change other properties. Often the best material for an application will be the material that has the best combination of properties.

Many different processes are used to make plastics into useful shapes. The processes used to mold or shape thermoplastics softens the material so it can be Injected into a mold, extruded through a die, or formed in/over a mold.

Thermoplastics generally can be reheated, reformed, and reused to produce new materials. Thermosets must use a process that allows the material to liquefy and flow into the designated shape and become polymerized or cross-linked and rigid. The material cannot be re-melted or recycled after cross-linking occurs. Processing Techniques are discussed in the next module.