Solutions to Homework Number Six
Due Monday December 7, 2015

1) Someone at your job, not a Kettering Engineer, makes the following statement: "Brazing is just high temperature soldering" another says Brazing is really low temperature welding ". Professionally respond.

Both soldering and brazing are non-fusion metallurgical joining processes. In such processes the filler metal but not the base metal does not. One very common set of definitions states that soldering occurs at temperatures below 450°C (840°F), and that brazing occurs at temperatures above 450°C (840°F). Therefore, brazing is fundamentally different from welding where the base metal is melted. This could lead one to think that "brazing is just high temperature soldering".

This misconception could be furthered as, because both brazing and soldering are non-fusion metallurgical joining processes; there are similarities. Both processes require the use of flux to remove and prevent oxidation and enable capillary action ("sucking molten metal into the joint").

There are historical and practical reasons for the line at 450°C (840°F). This includes solder alloys being based on tin (Sn) and brazing alloys based on brass (a Cu-Zn alloy), and the highest temperature solder alloy melting around 350°C and the lowest temperature brazing alloy melting around 540°C. There are several key reasons that brazing is not simply high temperature soldering.

The lower temperature associated with soldering requires more aggressive fluxes and cleaning. Soldering occurs with a combination of very different alloys. This causes the interfaces to be made of brittle compounds. This is not true with brazing.

Note, the 450°C (840°F) temperature line is the least important (and possibly unimportant) part of the definitions which distinguish soldering from brazing.

2) Compare SMAW, MIG, spot welding, and thermit welding (the HW only required SMAW and spot, but this is a good review of more)

Welding occurs when the base material melts and resolidifies forming a joint. If a filler metal is used in welding, the molten metals mix prior to solidification. When welding the following are required.

- A heat source is required to melt metal.
- The molten weld pool must be protected from oxygen. Otherwise an oxide will form on the surface of the weld pool and a good joint will not form.

Both arc and spot welding use electricity, however they are very different. Arc welding processes use an electric arc as a heat source. The electric arc can be thought of as a localized bolt of lightning generated by a large voltage difference between metals across air. Spot welding uses electric current to melt the metal and create the weld.

Stick (SMAW) or TIG (GTAW) are arc welding processes. In both processes the arc is created by the welding rod or wire.Stick and TIG welding differ in the way the weld pool is protected. The welding rod used in stick welding is coated by a flux. This flux evaporates during the welding process. The gas shields the weld pool and prevents oxygen from reacting with the molten metal. In TIG welding an inert gas is forced over the weld pool. This too “pushes” oxygen from the molten metal surface.

In stick welding (SMAW) the electrode is consumed as the process continues. In TIG welding the electrode is considered to be non-consumable. It is made of tungsten, a very high melting temperature material. Filler rod is often used in TIG welding, where it is not used in stick welding.

In thermit welding a chemical reaction is used to generate heat. Aluminum and iron-oxide are mixed and this is lit. The products of the reaction are aluminum oxide, and molten iron. The heat of the reaction is sufficient to melt iron. Aluminum oxide is only 30% as dense as molten iron. Thus it floats to the top protecting the weld pool.

3) During the 10th Week Practica you will make a plate through injection molding and a tray pattern through thermoforming. Compare these processes to those learned earlier in the course.

Injection molding is similar to die casting. Molten material is forced through a die into a mold cavity. The molds in both processes are permanent. The injection molding machine used in the polymer processing practica uses extrusion to force the molten polymer through the die. Polymer pellets are poured into a hopper (funnel). These are heated up, under the pressure applied by a screw of increasing diameter. The polymer melts and becomes a viscous liquid which is forced into a mold cavity.

Thermoforming is similar to a forging process. A sheet of thermoplastic material is heated up and a pattern is forced onto the sheet. Rather than using a direct compressive force, in the practica one will use a vacuum to create a pressure difference and thus a compressive force.