PLASTIC PIPING SYSTEMS & SOLVENT CEMENTING

Over the last forty years, plastic piping systems have gone from virtually unknown to some of the most used systems in both process (pressurized) and waste (gravity fed) applications. The generic term 'Plastic' encompasses many different materials with so many characteristics that it would take a book or two to list them all. However if we confine our inquiry to piping systems, we can narrow down the field and divide *plastics* into two families–thermosets and thermoplastics. Although there are numerous differences between the two groups, the major distinguishing factor is that thermosets harden with heat while thermoplastics are softened by it. Thermoplastics however are by far the more utilized in both industrial and plumbing applications, so let's take a closer look at this group. PVC, CPVC, ABS, PP, ECTFE …. on and on the alphabet soup goes. Fortunately it can all be condensed into three major families + the *odd man* out:

- The Vinyl family
- The Polyolefin family
- The Fluoropolymer family
- ABS

Whereas physical, chemical and thermal properties vary greatly among thermoplastics (covering a broad range of applications) there are a few, very desirable, properties that they all share:

Light weight – easy to transport, install, support.

High chemical resistance – thermoplastics are far superior than most metals, including many exotic ones, at a fraction of the cost.

Corrosion resistance – unlike all metals (including Stainless) which eventually oxidize (rust), pit and scale (Figure1) or are subject to galvanic corrosion when buried, these materials exhibit no such problems, maintaining a full ID throughout their entire service life.

Figure 1

Extremely low roughness factor – only polished metals can match the smooth surface finish of the most common thermoplastics. Lower roughness translates to smaller diameters, less friction losses, smaller pumps, etc. adding up to substantial savings.

Superior insulation properties – all thermoplastics are very low heat conductors requiring much less energy or insulation to maintain the desired temperature of the flow (chilled or hot). Once again, costs are much lower.

Cleanliness – in installations where it is important that the piping does not contribute contaminants to the flow, thermoplastics exhibit what is perhaps one of the most amazing characteristics; *they get cleaner and cleaner over time*. Metals, by contrast, get dirtier and dirtier.

The next thing to consider is the ease of assembly of thermoplastics vs. metals. Mechanical joints (e.g. flanges, threads, etc.) are equally available for both types of materials but lining up two 20ft pieces of 4" carbon steel so they can be flanged together is quite a bit more difficult than attempting the same thing with substantially lighter pieces of plastic pipe. Also, all mechanical connections have the tendency to leak over time and/or require constant maintenance. These are some of the reasons why permanent joints are much more desirable in most industrial and plumbing applications.

But as we turn our attention to permanent jointing things change dramatically. There are no longer only differences between thermoplastic and metals but among the 4 different thermoplastics as well (Vinyls, Polyolefins, Fluoropolymers, and ABS).

The only way to permanently join all metals, Polyolefins and Fluoropolymers is through some kind of welding process. Whether the components are directly welded to each other or an addition of melted material is needed, these processes are complex, require (often expensive) equipment used by highly trained installers, and can be cumbersome and difficult to perform in tight spaces.

Only piping systems manufactured using either Vinyls (PVC & CPVC) or ABS materials lend themselves to a very unique and effective permanent jointing process which has none of the above listed limitations – ***Solvent Cementing.***

I can already 'hear' many readers say "Oh sure, glued systems"; well, not quite.

Solvent cements were developed in the 1950's by IPS® Corporation under the Weld-On® brand name, creating a simple solution to the problems contractors faced in joining pipe.
Besides the very substantial formulation differences between glues (adhesives) and cements, there is an extremely fundamental difference with regard to 'how they work'. Glue bonds the two parts--think of it as two flat pieces of any material with a piece of chewing gum in-between. Without the gum the two pieces wouldn't stick. This means that a glued joint needs the glue to remain as the bonding agent and, to be leak-proof, the glue must be evenly distributed over the entire surface to be sealed.

A solvent cement joint, by contrast, is a *chemical fusion* that occurs between two identical materials. In our solvent cement joint we actually require substrate to substrate (e.g. OD of the pipe and ID of the fitting) contact because the chemicals in the solvent cement are not the 'glue' that holds the pieces together but rather they are what allow the materials to fuse together. As long as the surfaces of the two components to be joined are properly prepped and coated with the right amount of cement (to fill any gaps), they will *fuse* where there is direct contact between the parts and *bond* where there are gaps. For this reason, fitting sockets are tapered and the most important part of a solvent cement joint is the bottom 1/3 of the fitting socket; that's the area where there is interference (contact) between the pipe and the fitting and thus that is the <u>fusion</u> area. A properly constructed and cured solvent cement joint will exhibit a greater resistance to pressure than the individual components that make up that connection.

From an installation stand point, the tremendous advantage of solvent cementing is that no bulky/expensive equipment is required to obtain high integrity/permanent connections and that training of inexperienced personnel is very straight forward and can be performed in a few short hours.

Let's take a very generic look at the process and what it entails.

There are three basic products that are used in solvent cementing:

1. Cleaner
2. Primer
3. Cement

1. The use of **cleaners** is not always a must. However if dirt, grease, oil or surface impurities are present on the areas to be jointed, a cleaner must be used. Two things are very important to note: (a) Cleaners are not interchangeable with Primers and (b) when used, Cleaners must be allowed to evaporate completely before moving on to the next phase.

Figure 2

2. **Primers** are often the least understood part of this process and yet they are as important as the cement itself. Correct use of primers is essential to prepare (soften) the surfaces of the pipe and fitting so that the fusion process can occur. To work properly primers must be vigorously scrubbed into the surface; we are not *painting*, we are priming! (Figure 2) Two applications of primer are necessary for the valve or fitting vs. one for the pipe. This is due to the different manufacturing processes between the two components--extrusion for the pipe and injection molding for the valve or fitting. Unlike the step before, the step from primer to cement MUST be performed when the primer is still wet.

One-step cements (no primer required) are available for less demanding applications, but we'll have to leave that discussion for some other time.

3. The final phase is the application of **cement**. For the most part, cements must be material specific (PVC, CPVC or ABS) and must be selected based on the application (pressure, non pressure, chemicals, sizes, temperatures, etc.). Once the right cement is chosen and with our pipe and valve/fitting still wet with primer, we apply the cement to the surfaces to be joined. This time we go over the pipe twice and only once inside the socket. This is done because we do not want too much cement inside the socket which would puddle inside the socket thus damaging the valve or restricting the joint ID.

By contrast, be generous with the cement application on the pipe, as the excess cement will be dragged out of the joint and give you a nice seal around the mouth of the socket, plus it is easy to wipe off. It is now time to insert the pipe into the socket, twisting the pipe ¼ turn as it is inserted (twisting is not necessary if using a pipe-puller). Stop twisting as you bottom out, and then hold the pipe down for a few seconds to prevent the fitting taper from kicking it out. Your joint is now done! (Figure 3) Note that cure time before handling and pressure testing will vary greatly based on sizes and working temperature.

The above description is not meant to be a 'how to' instruction which would include additional important steps. However, solvent cementing is relatively simple/inexpensive and the reason why Vinyl and ABS systems are often preferred. But such simplicity sometime leads to the erroneous perception of it being a 'less effective' method. That's incorrect; although proper cementing does require training and the strict observance/implementation of specific steps, cementing remains a simple process which produces exceptionally tough, permanent joints with remarkable yield and a life expectancy well beyond what the individual components can offer.

For more information contact PEP Plastics

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