HOT DIP COATING OF VINYL PLASTISOLS

Hot dip coating of vinyl plastisols is a common method of applying a protective, decorative, or functional vinyl plastisol coating on a variety of metal parts. Typical applications include products such as tool handles and outdoor play equipment.

Part Cleaning

Parts to be plastisol coated should be chemically cleaned and phosphate or chromate treated in accordance to practices commonly used to prepare substrates for paint applications. Alternately, substrates may be vapor degreased, however this is generally not the preferred method.

Removal of contaminants from the substrates results in better primer adhesion. Phosphate or chromate treatments will give adhesion superior to that achieved on metal, which has only been cleaned, as well as improving the corrosion resistance of the metal substrate. Cleaning of the substrate also decreases the possibility of "poisoning" the primer and plastisol liquids with contaminants from the metal.

Part Priming

Vinyl plastisol by itself has negligible adhesion to metal and requires priming if adhesion is desired. Primers may be either spray applied with conventional air spray equipment or dip applied from a tank. Primer dip tanks are conventionally equipped with a re-circulating pump or other forms of agitation equipment in order to prevent sedimentation of pigments and stratification due to solvent evaporation. Primer tanks should also be monitored for viscosity increases due to evaporation and corrected with thinner to maintain a fairly consistent solids level.

The prepared metal substrate is coated with primer on all sections where plastisol adhesion is desired, flash dried and baked to a surface metal temperature between 350ºF (177ºC) and 400ºF (204ºC). This operation is necessary for the conversion of the primer polymer system and sets up the part for the hot dipping operation.

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Part Dipping

The primed part, hot from the primer conversion bake, is immersed in the liquid vinyl plastisol. All hot parts of the substrate immersed in the liquid plastisol will coat upon withdrawal from the liquid plastisol with a layer of semi-fused vinyl plastisol. The amount deposited will depend on the length of time the part was immersed, the metal temperature that the part was immersed at, and the vinyl plastisol formulation. The higher the metal temperature and/or the longer the immersion time equals the greater the film thickness deposited with a constant plastisol formulation.

As a general practice, the mechanics of dipping the part should allow for immersing the part vertically into the tank and withdrawing it vertically out of the tank. These operations should be performed at a uniform, slow rate to achieve a uniform surface of plastisol gel on the part, minimizing plastisol runs and drips and the incorporation of air bubbles in the plastisol coating. Dragging the part through the liquid plastisol tank usually gives very poor results. The dip angle and orientation of the part should be done in such a manner as to avoid the development of air pockets in part recesses.

Vinyl Plastisol Fusion

The part covered with the semi-fused vinyl plastisol is baked to a film temperature between 300ºF (149ºC) to 350ºF (177ºC), depending upon the specific plastisol formula. Sometimes conveying the part back through the primer oven accomplishes this also. However, greater flexibility in processing weighs heavily in favor of a second, separate oven for this operation.

Cooling the Coated Part

When the hot part coated with fused vinyl plastisol comes out of the oven, it is very sensitive to surface marring. It is advisable to cool the piece down to a maximum of 120ºF (49ºC) before handling. Water sprays or cold air circulation or a combination of both usually accomplishes this. Frequently, the parts are simply placed in a tank of circulating cool water.

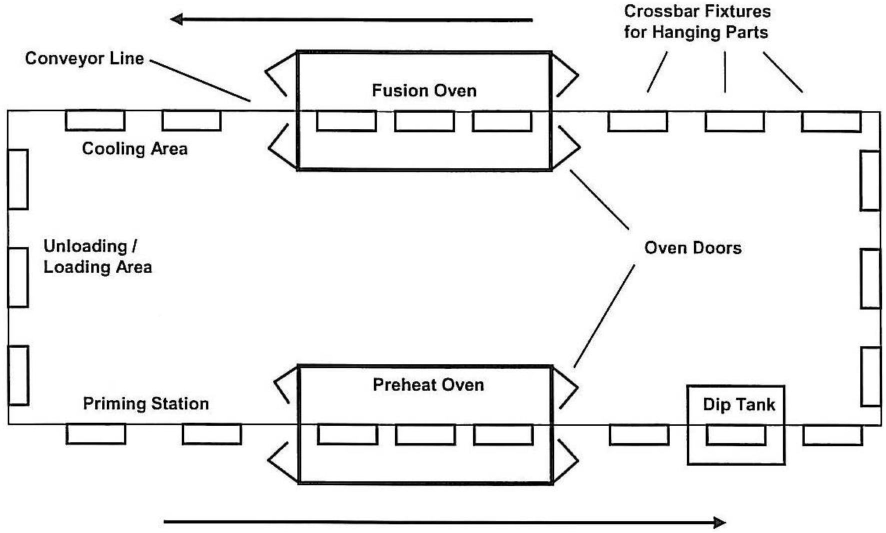
Basic Line Design

As a clean part helps to promote overall plastisol coating performance, many lines also incorporate complete cleaning / phosphate pretreatment equipment prior to priming or preheating. If parts require a primer, they can be coated prior to loading or in-line at some point prior to the preheat oven.

The length of the ovens is dependent upon capacity requirements. It is necessary to have separate oven temperature controls. Plastisol ovens need at least the capability of 450ºF (232ºC) for preheat / fusion sides. Convection heating is preferred to infrared heat sources. Air circulation within the ovens is needed to prevent hot spots and provide adequate exhaust. Doors that open when the conveyor is indexing helps in maintaining uniform oven temperatures and minimizes heat loss.

The conveyor should be variable speed, indexing as it passes through both ovens.

The dip tank needs to be located as close as feasible to the preheat oven to ensure that the parts being coated are as hot as possible. A hydraulic cylinder can be used to raise and lower the dip tank. It is important that the tank movement speed, both up and down, be carefully controlled.



Basic Dip Tank Design

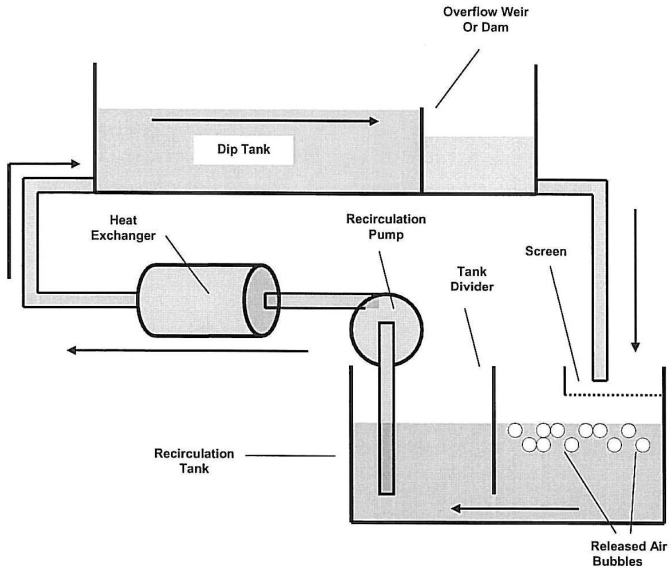
The vinyl plastisol circulates through the system to assist in warming and / or cooling of the plastisol, remove lumps or foreign particles, to reduce air entrapment and to mildly agitate the plastisol to prevent settling and maintain a uniform viscosity.

The dip tank itself can be elevated up and down by mechanical means to dip parts, or can be stationary when parts are hand dipped. If the tank is elevated up and down, the system should be equipped with an infinitely variable drive and move without any sudden changes of speed. Tank materials of construction can consist of steel, aluminum or polyethylene. The design should take all environmental factors into account during the design phase. The dip tank should be equipped with an overflow weir or dam. As the plastisol flows over the weir, some entrained air will be released from the plastisol, which will help control the quality of the plastisol coating.

Between the dip tank and the recirculation tank, the plastisol should pass through a filter or screen. The filter or screen will remove gelled plastisol sloughed from parts, or any large foreign contamination.

The recirculation tank should be equipped with a dividing wall, which breaks the liquid surface of plastisol and allows the plastisol to flow under it. This initial section of the tank will allow entrained air bubbles to escape from the plastisol and be retained on the surface of the plastisol.

The selection of the recirculating pump should be done so as to minimize any heat build up in the plastisol, or result in the introduction of air into the plastisol. It is recommended that the recirculation pump be either an air operated piston pump or low rpm (120 rpm maximum) gear pump. Double diaphragm pumps can also be utilized.



A system for warming or cooling the plastisol may also be included. A coil can also be placed on the floor of the dip tank, versus the use of an external heat exchanger. If water coil is used to cool the plastisol inside the dip tank, the coil and all water piping must be below the plastisol level inside the dip to prevent any condensation from entering the tank.

Consideration may also be given to the installation of a vacuum de-aeration device, to assist in the removal of entrained air from the plastisol. To minimize air entrainment into the plastisol, the return inlet to the dip tank should be below the plastisol level and the plastisol should not be allowed to "free fall" at any time.

Table 1: PLATISOL DIP COATING EQUIPMENT MANUFACTUERS

The following list of companies provides just a few companies that produce equipment for dip coating of plastisols. This list was developed for the use of our customers only. The appearance of a supplier on this list does not constitute a recommendation by PolyOne Corporation, nor does the absence of a company constitute a lack of recommendation by PolyOne Corporation.

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