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Coating Innovations
for Electronics

TI TECHNICAL INFORMATION

TI 15/14: Advice on the handling and use of gear feed pumps in curtain/spray coating equipment

Within the scope of our quality management system we collect practical information that has been proven to be particularly important for a safe and reliable production flow.

This technical information sheet gives advice on the optimum handling and use of feed pumps in curtain/spray coating equipment to achieve a continuous flow rate and thus an even coating result.

Without the use of pumps the feeding of coating material in a curtain/spray coating line would be impossible. Since the pumps must generate a continuous flow to create an even and non-pulsing coating curtain or volume flow, gear feed pumps have proven to be the most suitable type, whereby it is of little importance whether the pumps are ”inner” or ”outer” geared. When selecting a pump longest possible standing times and/or ease of maintenance are the main factors.

Principally, many factors have an influence upon the service life of a pump. Generally, it should be mentioned that pumps involve rotating mechanics that on account of their construction are subject to normal wear and tear. During their service life pumps need a medium that exhibits lubricating properties – this role is assumed by the medium to be pumped, in this case by the solder resist. Depending on which pump type and/or make is used the pump manufacturer grants a service life of 6 to 8 months for pumps that work with high solids coatings. Experience has shown that such a life span can be achieved, and in many cases considerably exceeded, without any problems.

There are some basic rules that have to be observed to increase the service life of a pump and counteract increased wear. Here, not only the kind of prevention plays an important role but also the frequency of the measures taken.

For spray coating units, it is also possible to use a diaphragm pump. Enabling a non-pulsing flow rate in spray coating units, this type of pump is often a better and longer lasting alternative despite its higher acquisition cost. Diaphragm pumps are not suitable for curtain coating units.

Below we will highlight some important points that can influence the standing time of a pump significantly.

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Filter

The filter in the coating line must be exchanged at regular intervals, for instance once a week. Since foreign particles can enter the coating cycle via the coating curtain or within the coating recovery in spray coating units, the filter clogs over time. If the filter is not exchanged regularly the amount of coating that passes through the filter decreases and the pump must build up a higher pressure to transport the same coating quantity within the same time which inevitably leads to increased wear.

The choice of the right filter is also important. When using filters where the pores are too small the pump must also increase the pressure to feed the same coating quantity which equally heightens the stress on the pump. The use of filters with a pore fineness between 120 and 150 µm is absolutely sufficient.

When choosing a too fine filter there is the risk that certain coating components are filtered out which may change the composition of the solder resist.

Thus the use of a suitable filter as well as its exchange at regular intervals is recommended.

Slit width (curtain coating units only)

Besides the right choice of filter and its exchange at regular intervals the choice of the parameters for the pouring slit also influences the pump load. Generally, the wet ink weight is adjusted with a consistent pouring slit by increasing or reducing the flow rate of the pump. Here the rate is simply controlled by means of the number of revolutions. If a narrower pouring slit is chosen the pump revolutions must be increased accordingly to increase the wet ink weight and thus the pressure the pump must create automatically rises. Thus the stress on the pump is of course lower when a larger slit is selected. Pouring slit widths commonly range between 0.3 and 0.6 mm.

Cleaning

It is recommended to clean the coating line at regular intervals (for instance once per month). Since there are always zones within the coating circuit where the coating circulation is poorer, in those places sedimentation / agglomeration may result. If these substances break free either the filter clogs (see item “Filter”) or an increased mechanical stress of the pump on account of the sedimenting material results. Ultimately both effect a higher pump load and thus higher wear.

When cleaning, several points must, however, be observed that also influence the pump wear. On account of the fact that solvents do not exhibit any, or only very low, lubricating properties cleaning has to be effected carefully. First of all, the complete coating material should be drained from the equipment. Then the unit should be pre-cleaned with a small quantity of solvents. After draining of the solvent, cleaning is repeated with fresh solvent whereby special care must be taken that the equipment is run as short as possible to keep the stress on the pump to a minimum. The number of pump revolutions should be set as low as possible.

Material throughput

Photoimageable solder resists are 2-pack systems with a limited processing time. On account of the chemical cross-linking reaction of the system the binding molecules will grow, causing faster clogging of the filter which leads to a higher pump load. Thus cleaning plus replacement of the filter and the coating should be performed at regular intervals especially in case of a very low throughput.

Shut-down of the coating line

Principally, the coating circuit of the coating line should always be in operation. This also applies to periods where the unit is not in use. However, in this case the flow rate should or may be reduced. Continuous operation avoids potential sedimentation within the coating circuit. As a rule, any existing sediment that forms is not stirred optimally when the equipment is restarted. Thus the coating composition is changed on the one hand, and on the other hand larger particles resulting from the sedimentation can dislodge leading to damage within the pump or clogging of the filter. Both effect a higher pump wear.

Maintenance

From the production point of view maintenance work is a “nuisance” as it costs time, manpower and money. But nevertheless it is absolutely essential to ensure the service life of the equipment and guarantee uniform quality.

Besides the above mentioned items such as cleaning/rinsing and filter replacement, maintenance should include dismantling, cleaning and reinstallation of the complete coating circuit including the pump at regular intervals.

Generally dismantling is very simple, but during reinstallation special attention has to be paid to the adjustment of the pump. Even though the pumps are normally fitted with magnetic clutches to protect them against damage from too high a torque or from stopping lateral powers can be transferred that lead to increased wear or destruction of the pump. Therefore, the pumps have to be adjusted with the magnetic clutch perfectly aligned. Please also observe the notes of the pump/equipment manufacturer.

Viscosity measuring

Finally we want to address the topic of viscosity measuring by means of a flow cup. Principally all flow cups look very similar. Besides the cup volume the nozzle through which the coating flows is decisive for the exact measuring of the viscosity. There are differences in the diameter and length of the nozzle that have a big influence on the measured flow time. The viscosity at which our 2-pack solder resists of the series Elpemer® GL 2467 are to be processed for instance is determined acc. to DIN 53 211 by means of a 4 mm cup (The DIN 53211 has been replaced by the international norm ISO 2431. However, on account of the widespread use of the 4 mm DIN flow cup we continue to specify the viscosity acc. to DIN 53 211.). The figure 4 mm indicates the nozzle diameter. The nozzle length is standardized. It must be ensured that the nozzle is clean. If there are contaminations within the nozzle they must be carefully removed so that there is no damage to the nozzle. If the nozzle is cleaned with mechanical tools this can enlarge the nozzle and thus lead to incorrect measurements.

Utmost caution is advised even once a 4 mm flow cup is in-hand since there is still a difference between a DIN cup and an ISO cup. Even though the nozzle diameter is the same, the nozzle lengths are different. Therefore variations in the viscosity measurement result.

Finally, here are a few notes on the correct determination method:

The temperature has a big influence on the viscosity. A temperature difference of 5 °C [41 °F] can lead to a difference in viscosity of up to 10% or more. To obtain meaningful, reproducible viscosity measurements it has to be ensured that they are always performed at the same temperature.

The measurement of the viscosity in the form of flow time is effected with flow cups according to DIN 53 211 or ISO 2431 as follows:

➔ Place the flow cup on a filling stand/tripod or in a tempering beaker so that the top edge is perfectly level.

➔ Place finger under orifice to seal.

➔ Fill the cup completely with coating.

➔ Push a glass plate over the cup so that excess coating is evenly transferred to the outer edges of the cup and the cup is closed. Remove the glass plate horizontally.

➔ Release finger from orifice while starting a stopwatch.

➔ Stop the time measurement as soon as the liquid flow breaks for the first time.

The measured time is the flow time in seconds.

➔ Perform the measurement three times and average the measured values.

In practice the viscosity of a curtain coating material generally is measured directly in the ink tank of the curtain coating line. Here the time is started when the flow cup is pulled out of the coating material.

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