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ZESTRON High Precision Cleaning News

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Vapor Recovery Systems, Engineered by ZESTRON

The knowledge behind mist recovery is drawn from many years of research across a wide range of industries and the use of associated recovery devices has waxed and waned. Recently, however, the demand to recover and reuse waste vapor by utilizing highly efficient systems has increased dramatically across every manufacturing sector.

This is not surprising given the economic situation since vapor recovery is a relatively simple and effective way to reduce unnecessary operational costs and eliminate emission standards violations. As a result, there are many different methods for reducing the VOC concentration in a vapor stream and procedures such as combustion, adsorption, absorption (scrubbing), and condensation are currently available. While each method has well documented advantages and disadvantages that must be considered, it is equally important to consider the significant implications that device technology has on the efficiency of operation and the proper operation of the associated equipment.

Since demisters are becoming more common in PCB defluxing applications, many customers are experiencing the pitfalls of poor device design. Pressure drops, flux leaks, low recovery efficiency, fan blower strain, and unnecessary machine modifications can all be traced back to poor demister design and cheap device construction.

Numerous customer complaints about currently available devices led ZESTRON engineers to look for a better solution. The two primary issues that required immediate attention were related to pressure drops and efficiency.

Pressure drops created by poorly designed demisters are very serious since they affect the proper airflow and ventilation of the cleaning equipment and often place unnecessary strain on the associated fan blower. In response to this problem, demister suppliers often fault the cleaning equipment manufacturers and recommend that the customer consult with an HVAC specialist to modify the ductwork or to increase the horsepower of the blower.

Figure 1: *ZESTRON® Demister*

Unfortunately, these suggestions are, at best, short term solutions that do not address the root cause. Over time, the vapor carries residues into the packing material and airflow is restricted until the pressure drop increases to a point where the equipment ventilation is negatively impacted and strain on the fan blower is increased. Flux material can often be seen leaking from the units onto expensive cleaning equipment and the already low vapor recovery efficiency is further reduced.

Efficiency is much more than a measure of how well the unit is working. In vapor recovery, efficiency is money! While demisters passively return vapor containing cleaning chemistry back to the wash tank for reuse, they are no match for condensers. ZESTRON engineers have designed a condenser technology, which eliminates all concerns over pressure drops and machine issues, while delivering unparalleled efficiency (see case study on page 2).

As always, ZESTRON R&D projects are customer driven. Our ongoing efforts to reduce cleaning costs coupled with substantial negative feedback about currently available devices have resulted in the successful development of completely novel demister and condenser technology. ZESTRON demisters and condensers are specifically designed for the recovery of exhaust vapors originating from automated cleaning processes without negatively effecting the operation of associated equipment. The impact on the annual cleaning costs can be dramatic. Furthermore, VOC emissions are also significantly reduced, which can help customers meet the stringent local environmental regulations.

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Tremendous Process Savings through Vapor Recovery

Zentech Manufacturing, Inc. is a full-service Electronics Manufacturing Service (EMS) company based out of Baltimore, MD, offering high speed, precision assembly of printed circuit boards. Zentech provides a full range of PCB assembly, PCB testing and PCB design services.

The current inline cleaning process requires high temperature as well as high spray pressure settings, which lead to high evaporative losses.
High evaporative losses mean higher costs for the entire cleaning process. A highly efficient vapor recovery device is needed to dramatically reduce evaporative losses and thus overall cost. Furthermore, this device must be easy to use, reliable, and virtually maintenance free.

Inline cleaning equipment is characterized by high process temperatures, high pressure settings, and conveyorized transfer of cleaned parts.
These machines are normally used for higher production throughput. The wash solution is a mixture of the chemical cleaning agent and DI-water.

The evaporation process inside the wash section begins as soon as the wash pump recirculates the solution through the spray bars. The nozzles on the spray bars create a pressurized mist that is easily converted to vapor, which is transferred through the exhaust system.

As the negative pressure extracts the vapors created inside the inline machine, the wash section loses the working solution which leads to fluctuations in the bath concentration, the wash tank level and the energy losses. To prevent these losses, it is recommended to implement a vapor recovery device with heat exchanging capabilities to condense the evaporated bath solution and effectively return it to the wash tank.

One of the evaporative recovery systems from ZESTRON Corporation is the ZESTRON® Condenser. ZESTRON's engineering team has designed a system that is able to achieve a recovery efficiency of up to 85%.

Requirements for the installation at the customer's site were pre-defined as follows:

- ✓ Chiller unit
- ✓ Sufficient clearance to the ceiling
- ✓ Ceiling support for the unit
- ✓ Sufficient exhaust capability

During the installation process, the engineering team evaluated the current exhaust system layout and CFM capabilities.
The clearance from the top of the machine to the ceiling as well as the surrounding footprint of the chiller unit inside the facility had to be verified.

After verification, the ZESTRON® Condenser was installed along with the chiller and Zentech started recording the performance of the unit.

Table 1 and 2 illustrate the wash process parameters used at Zentech Manufacturing throughout this evaluation:

The successful installation was completed with on-site technical support from ZESTRON's Application Technology Department and continuous assistance from the ZESTRON Sales Department. Having consistent customer support and direct engineering contacts on-site, Zentech Manufacturing, Inc. ran the cleaning process with the required process parameters, i.e. high wash temperatures and high pressures without high evaporative losses. "With the newly installed ZESTRON® Condenser, Zentech Manufacturing Inc. was able to bring the evaporation losses down by 85% on average which resulted in savings of 46% in chemistry cost monthly," according to Dave Hughes, Director of Quality, Zentech Manufacturing, Inc.

	Upper nozzle pressure (psi)	Lower nozzle pressure (psi)
Prewash	47	47
Wash	85	63
Hurricane	68	N/A
Chemical Isolation	22	22
Rinse	90	60
Final Rinse	28	26

Table 1: *Equipment Settings*

Overall Process Parameters	
Wash Tank	135°F - 145°F
Dryer 1	130°F
Dryer 2 + I. R.	160°F
Belt Speed	2 fpm
Resistivity	10 MΩ
Final Rinse Flow	3.2 gpm
Cleaning Agent	VIGON® A 200+
Concentration	15%

Table 2: *Overall Process Parameters*

Alternative Medium to IPA-water Mixture for More Accurate Ionic Readings

Numerous test methods (i.e. ROSE test-IPC TM650 2.3.25.1, IPC TM 650 Method 2.3.28 and MIL-P-28809 section 4.8.3) are used to determine cleanliness. These test methods include, but are not limited to ionic contamination and ion chromatography. IPA-Water mixture (75 % / 25 %) is used for both standards as an extraction medium.

One of the drawbacks of this method is that solvency of the medium is directly proportional to temperature.
Increasing the temperature, increases solvent's ability to dissolve solids. Once the solvent cools down to room temperature this physical process becomes fully reversible and results in the precipitation of solids which are not soluble at room temperature. Heating IPA-Water to increase solvency might not be a solution to the initial problem of the poor solvency of IPA-Water mixture.

Residues can be classified as ionic and non-ionic. The selection of a "solvent" (dilution of organic solvents and water) and a highly polar liquid (i.e. water) is required to act as a viable extracting agent. The rationale is that the polar liquid (i.e. water) is used to solubilize all inorganic compounds and the solvent is used to solubilize non-ionic contamination (i.e. resins).
Water becomes most important to make the ionic contamination measurement work. The limitation is that in order for water to be able to solubilize inorganic residues it first has to get past the resin layers, which are organic and insoluble in water (RMA, No-cleans).

As the IPA-Water mixture has already struggled with solvency prior to the introduction of lead-free products, the problem is now further compounded. A generally well understood unit for the "cleaning power" of a solvent is the Kauri Butanol value (Kb-value). It is an international, standardized measure for a hydrocarbon solvent and is governed by an ASTM standardized test – the ASTM D1133. The result of this test is an index, usually referred to as the "Kb-value". The higher the Kb-value, the more active is the cleaning agent. Mild cleaning agents have lower values whereas powerful cleaning agents, such as the old chlorinated solvents have higher values in the low hundreds.

To find better alternatives to IPA, ZESTRON's R&D is currently conducting an extensive study. The main objective was to find quick and cost-effective experiments to determine the solvency power of rosin and correlate the results with semi-thermodynamic parameters such as the Hansen Parameters or the Kb-value.

First, it was started with a rosin simulation system which is similar to the Kauri test and the contamination caused by real fluxes or solder pastes.

The chosen test solvents could be reduced from 20 to 5 after conducting first "solubilization trials". The table below shows the solvency power of top five solvents vs. IPA determined through the rosin simulation.

After the first trials, "real" lead-free and leaded solder pastes and fluxes were tested. The results were inspected for two basic standpoints: cleaning ratio and cosmetics. Final results will be published shortly.

Whichever modern, alternative mix one chooses (instead of the IPA-Water) one fact remains true: The alternative solution has to be capable of fully dissolving all remaining residues.

It could be for example, a mixture of solvents (polar and non-polar) in combination with water or alternatively a solution without water (i.e. DMF – Dimethylformamide).
The two alternatives to IPA are modern solvents or water-based product technologies. Modern solvents are water-free, demonstrate higher flash points and most importantly better cleaning results sand are much safer to use.

Conclusion:
Based on the conducted research, the authors conclude that none of the selected alternative solvents chosen are suitable alternatives to IPA. Hypothesis 1 and 2 could therefore not be validated.
However, one should point out, that IPA failed to show the required cleaning performance to remain a viable extraction fluid of choice for ion chromatography and ionic contamination.

It is fair to state that current, modern flux residues cannot compare to traditional RMA formulations as they provide a significantly more complex structure which impacts its ability for removal. At present, IPA-water demonstrates very limited cleaning performance, which in turn confirms that any analytical extraction method using this solvent mix cannot and will not provide an absolute cleanliness assessment, only a relative one. For high-end electronic assemblies this should not be accepted as a sufficient standard.

Future research:
The authors did not expect the observed findings, which has prompted further investigations to assess other viable processes to address the present deficiencies. Numerous collaborations have been initiated to include other partners to further examine supplemental tools to reach acceptable results.

Solvents	Results / Time dissolving the Manila Copal		Hansen Parameters			Dissolve in Solvent (75 %) Water (25 %)
			δ_D	δ_P	δ_H	
IPA	60 min	76 %	15.8	6.1	16.6	Yes
Ethanol	39 min	100 %	15.8	8.8	19.4	Yes
PM	30 min	100 %	15.6	6.3	11.6	Yes
MEK	20 min	100 %	16.0	9.0	5.1	Cloudy
NMP	40 min	100 %	18.0	12.3	7.2	Yes
DMF	30 min	100 %	17.4	13.7	11.3	Yes

Table 1: *Solvency power of Top 5 solvents vs. IPA*

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ZESTRON provides the best technical support and know-how for precision cleaning applications and services in the electronic manufacturing industry.

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ZESTRON to Open a New Technical Center in South East Asia

Since its foundation almost two decades ago, ZESTRON has been synonymous with worldwide, continuous growth within the electronics assemblies industry. Due to the ever increasing demand of being available around the globe, and more companies with global operations, ZESTRON's main objective is to provide our customers a very focused and consistent level of technical support by continuing to expand our facilities.

The global availability of ZESTRON products and services is now guaranteed through ZESTRON's three regional headquarters in North America, Europe and China. Currently 25 master degreed process and application engineers are responsible for delivering best technical support and optimal cleaning solutions to the global electronics market. To be able to offer our customers even more local presence and a quikker response to their needs, ZESTRON is currently establishing a new Technical and Analytical Center (Fig. 1) in Penang, Malaysia.

This is the 4th Technical Center for ZESTRON globally and it complements our European, American and Chinese facilities. The future facility will be located in the Kulim High Tech Park, about 13 miles west of Penang, Malaysia.
The new Technical Center with over 5,000 sq.ft. of floor space will be equipped with the latest American, European and South East Asian cleaning equipment such as spray-in-air, ultrasonic, etc. for defluxing, misprint and stencil cleaning applications for SMT as well as Semicon backend. Upon finishing the Technical Center, customers will be offered a full range of cleaning applications for free-of-charge cleaning trials and analytical services.
With this first state-of-the-art Technical Center in South East Asia, local customers will have the opportunity to personally attend cleaning evaluations and obtain immediate results.
Previously, customers were inconvenienced by having to send their assemblies to facilities overseas and obtain results only weeks later.

"ZESTRON's objective is to provide unparalleled technical service and to help customers evaluate and define the most appropriate cleaning processes. The depth of our technical support is what sets ZESTRON apart from our competition and building a globally cohesive team allows us to support global customers at their respective locations around the clock. This is particularly important as many multinational organizations rely more and more on outsourcing their assembly operations to South East Asia. This Technical Center will be complemented by two additional Centers in Asia in the near future. The official inauguration of the Malaysian facility is planned for the end of August 2009", said Dr. Harald Wack, President of ZESTRON during his recent trip to the area.

Figure 1: *New ZESTRON Building in Penang, Malaysia*