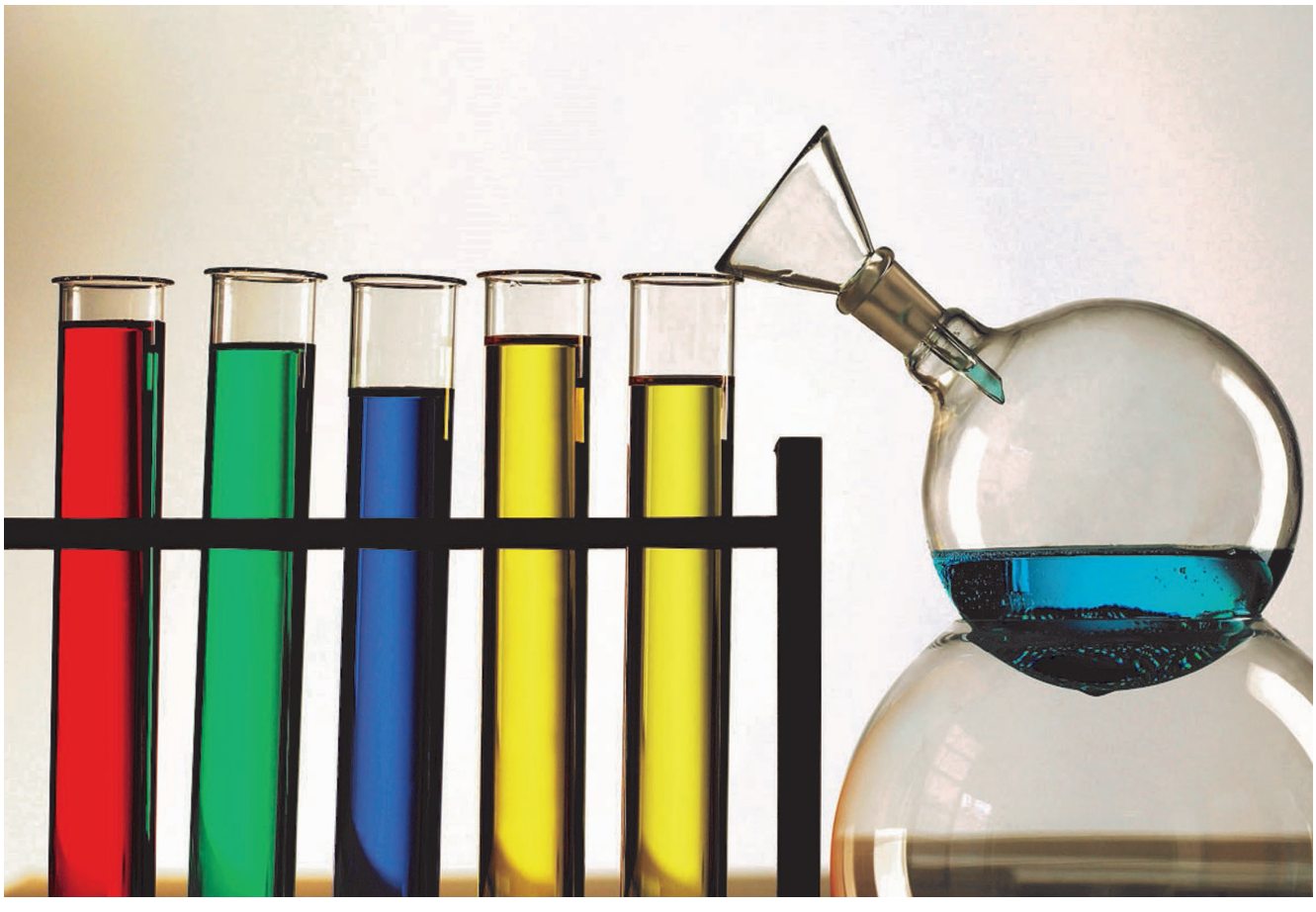
Cleaning of Production Equipment

Replacements for Problem Solvents

The REACH regulation on chemicals is intended to ensure a high level of protection for human health and the environment. Since it came into force, many substances previously used to clean production equipment have been reclassified. Companies are now required to replace products that are hazardous to employees with environmentally and user-friendly alternatives. Färber & Schmid presents a number of substitutes for the "stalwarts" among solvents. The first part of this two-part series focuses on the cleaning equipment used in PUR processing.



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The processing of polyurethane and of resin systems are two particular areas in which NMP (n-methylpyrrolidone), NEP (n-ethylpyrrolidone), DMF (dimethylformamide) and methylene chloride are still occasionally employed as solvents, although they pose a risk to the health of employees. Foremost among these are the cleaning of molds used in the production of molded PUR parts, purging of dosing lines or mixing-and-dosing heads in 2-component systems and the cleaning of encapsulation systems. But solvents are also used in the production of polymer dispersions and adhesives as well as in their removal.

As a result of increasing technical requirements, stricter environmental protection requirements and regulatory provisions, solutions to the various challenges are needed. In most cases, the necessary cleaning work is carried out manually, with brushes, paintbrushes and similar equipment on open and, above all, heated molds or in open production containers and tanks. Work personnel are thus directly exposed to these substances through inhalation, odor and possibly skin contact. Cleaning of closed systems, such as the purging of

mixing-and-dosing heads, is somewhat less critical in terms of workplace health and safety. Nevertheless, the same restrictions apply here as for "open" applications. Given the increasingly narrower classifications and labeling of established solvents under REACH, many users and processors are looking for functional alternatives.

Aside from technical functionality, the lowest-possible toxicity, best-possible environmental properties and positive workplace factors are usually at the forefront of this realignment. Färber & Schmid offers a range of cleaning products that serve as alternatives to the critical substances (**Table 1**).

These newly developed products offer a price-performance profile comparable to that of established solvents. In many cases, they have already passed their first field tests. In this first part of a series of articles, we look at replacements for NMP, NEP and DMF.

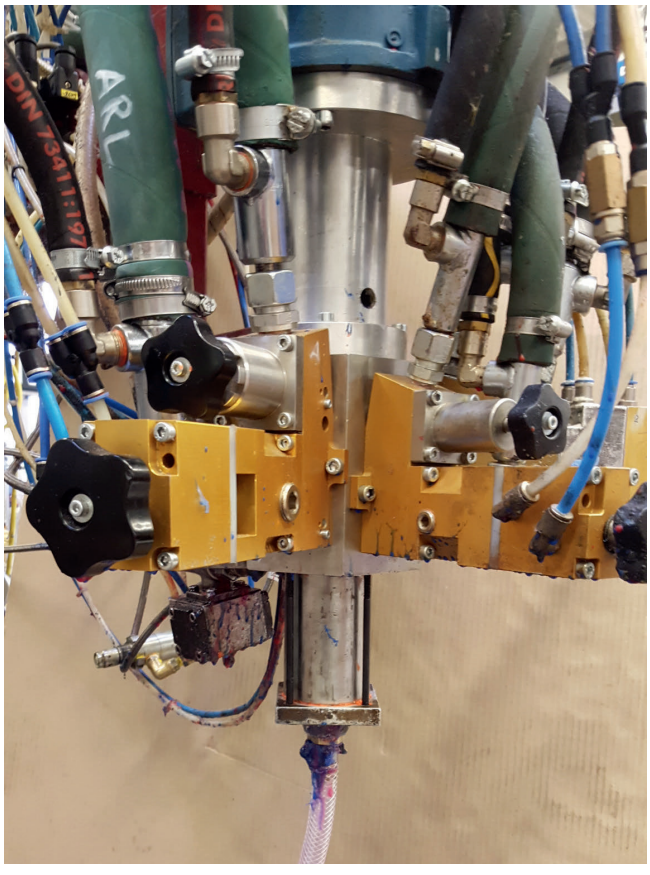

Fig. 1. This mixing head in PUR production was changed from DMF to a purging agent not subject to labeling requirements..

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High Dissolving Power – without NMP

A production company that manufactures polyurethane foam for numerous automotive applications as well as polyurethane elastomers by the hot casting process was using NMP to clean all its molds, hose lines, and containers for prepolymers. While mold cleaning usually involves removing residues of release agent, which in combination with cured isocyanates and polyols usually forms stubborn deposits under pressure and temperature during production, the purging of hose lines and containers for prepolymers calls for a purging agent that has high dissolving power but does not trigger a reaction of the isocyanate-functional compounds. For a long time, the company had been looking for alternatives that were not classified as toxic to the unborn child and that met the technical requirements in a comparable way to NMP. After the customer had described his specific requirements, two suitable products were recommended: Resin-Clean EXP-10/70 and Resin-Clean EXP-10/100. The latter is an aprotic cleaner that has no free OH groups and is therefore ideal for removing reactive premixes. Having passed an initial laboratory test, it underwent production trials under real conditions. The test phase was successful, the results were positive and met with approval, and now the two products are being used to great effect to clean all the machines and mold, at comparable cost and without endangering employees.

Cleaning Mold Parts Overnight in a Bath of Resin-Clean– without NEP

A manufacturer that makes parts for machinery making, special vehicle construction and conveyor technology with its own polyurethane elastomer formulations and Vulkollan had for some time been seeking a suitable replacement product capable of removing stubborn release agent residues. Hot casting of polyurethane elastomers is particularly prone to deposition of release agent residues on the mold surface and these are very difficult to remove because of the high temperatures involved. In the past, a NEP-based cleaner had been used for this. However, as a result of the reclassification of NEP under REACH, the previous supplier had developed a new NEP-free cleaner which it offered as an alternative. Since the molds are generally cleaned cold after production and the new cleaning product failed to match the »

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To Be Continued

Part two of the series covers replacing methylene chloride and acetone and removing isocyanate and will appear in Kunststoffe international 6/2022.

Digital Version

A PDF file of the article can be found at ***www.kunststoffe-international.com/archive***

German Version

Read the German version of the article in our magazine ***Kunststoffe*** or at ***www.kunststoffe.de***

Designation	Parameter	
"Old" products	**Flashpoint in °C**	**Labeling as per CLP**
N-methylpyrrolidone (NMP)	91	 H315 / H319 / H335 / H360D
N-ethylpyrrolidone (NEP)	91	 H318 / H360
Dimethylformamide (DMF)	58	 H226 / H312 / H319 / H332 / H360D
Methylene chloride	n.a.	 H315 / H319 / H336 / H351
"New" products	**Flashpoint in °C**	**Labeling as per CLP**
Resin-Clean HPT-D1	65	No labeling requirement
Resin-Clean HPT-PU 05	86	No labeling requirement
Resin-Clean HPT-73/DB	90	No labeling requirement
Resin-Clean EXP-10/70	90	 H315 / H319
Resin-Clean EXP-10/100	90	 H302 / H315 / H319
Resin-Clean EXP-3/M-V2	66	 H314 / H335

Legend (H-phrases):
H226: flammable liquid and vapor
H302: harmful if swallowed
H312: harmful in contact with skin
H314: causes severe skin burns and eye damage
H315: causes skin irritation
H319: causes severe eye irritation
H318: causes serious eye damage
H332: harmful if inhaled
H335: may cause respiratory irritation
H351: suspected of causing cancer
H360D: may damage the unborn child

Table 1. The upper part of the table lists the solvents frequently used in the past while the lower part shows the new substitutes. Source: Färber & Schmid

performance of its predecessor, the production team was very keen to reinstate the latter. This unsatisfactory situation soon led the customer to join the F&S application specialist in testing some cleaning products on site. A few quick tests followed by long-term trials revealed that the product was ideally suited. The company now uses Resin-Clean EXP-3/M-V2, which possesses extremely high dissolving power, especially at room temperature. The customer has purchased a suitable container for soaking the mold parts in the cleaning product overnight. When time is of the essence, manually brushing the parts with the product is an effective way to clean them.

Replacement for DMF: New Purging Agent for Mixing Heads

A company that manufactures seals of all kinds and molded PUR parts made with Vulkollan and Baytec had, until recently, been purging its mixing heads with the questionable solvent DMF. Toxicological concerns led to the testing of several alternatives, with Resin-Clean HPT-PU 05 ultimately emerging as the product of choice. As the purging agent has since proven itself over the long term and does not require labelling, a line in a newly constructed building at a different location will now also be equipped with the new purging agent.

A lack of viable alternatives has meant that DMF is still in use as a solvent today, especially for the cleaning of rolls in the laminating industry. Since DMF is classified as both acutely toxic and toxic to the unborn child, it poses significant problems for the user in terms of employee health and safety and environmental protection.

In collaboration with a user and a supplier in the textile industry, Färber & Schmid devised a solution for cleaning laminating rolls. The adhesives employed in the laminating process are often exposed to very high thermal stresses that give rise to very stubborn and burnt-in contaminants on the roll. The customer specified that he wanted to be able to dissolve and remove these contaminants with a user-friendly product at room temperature.

The special cleaner Solvetan that was developed for this purpose met the specification in full and impressed the customer over the course of extensive practical tests. Since then, Solvetan has been used to clean flame-laminating rolls and also to remove liquid PUR adhesives in the daily production process.

Tailored Solvents: Adapting to Customer Requirements

The products listed in these practical examples and the products shown in the table are merely a selection of the various options for dissolving and cleaning PUR and other polymer systems. If required, products can be custom developed and manufactured for specific applications. The competitive advantage of customized development products lies in the scope for freely adjusting certain physico-chemical parameters. As a result, even the most stringent requirements imposed on toxicology, ecology, application technology and economy can be targeted. The cleaning products can be used at both ambient and elevated temperatures. Very large parts, with upright mold walls which cannot be immersed, can be treated with thickened (viscous) cleaning products and solvents that cling to them and are highly efficacious. Aside from replacements for the solvents named above, environmentally friendly alternatives to acetone and MEK are also available. ■