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Solvent recovery with steam

Self-sustaining, high performance distillation plants and with state-of-the-art process standards contribute to cost minimisation and sustainable package printing

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Currently, the cost of one litre of clean solvent is about EUR 1.20. Depending on the number and utilization of the printing or platemaking machinery, package print shops have an average daily solvent consumption of 200–1500 l. This is mainly attributable to automatic cleaning processes for anilox rollers and printing cylinders and the cleaning of ink troughs, tubes and ink pumps. If all the solvent consumed were to be replaced by new solvent this would result in a significant cost increase. Therefore, the installation of a distillation plant for many package print shops is a reasonable investment with a fast pay-back mostly within a year.

OFRU Recycling develops, manufactures and distributes machines for the recycling of soiled flammable solvents and waste-water. Established in 1978 out of the American company *Ransburg Corporation* (today better known as *ITW Ransburg*), OFRU (which stands for *Oberflächentechnik Russau* – Surface Technique Russau) not only developed one of the first vacuum evaporators but also contributed considerably to the establishment of solvent distillation in Europe, which has gained the status as an acknowledged and reliable technology. Employing a current workforce of around 20 people, 70–80% of the equipment produced is exported. Above average growth has been achieved in markets like Russia, Latin America and the Middle East. Located in Babenhausen (near the Frankfurt am Main international airport) the company has

gained a good reputation and comprehensive know-how in the field of solvent recovery and distillation. Their service team provides customer support for the development of customized solutions. All in all, OFRU has gained the position as a worldwide leading specialist for solvent recovery and distillation.

Among their customers are *Anton Debatin GmbH*, a Bruchsal/D-based manufacturer of envelopes and temper-evident bags and package printing company *Leeb GmbH & Co KG* of Memmingen/D. In 2008, both companies installed a customized solvent recovery distillation plant.

Criteria for optimum design

OFRU Recycling offers solvent recovery plants directly connected to the respective production machine. To minimize the makeready times of

state-of-the-art printing presses, anilox rollers and printing cylinders are cleaned by automatic systems within the machine. The required amount of solvent depends on the number of print decks and the frequency of job changes, an amount of 10–12 litres of solvent is required per print deck. Important parameters for optimum design of the recovery plant are the consumption rate, the degree of soiling and the type of solvent used.

One technology – two types

Based on the above mentioned parameters, OFRU Recycling developed customized plant concepts for *Anton Debatin* and *Leeb*. Destined for the distillation of soiled solvent (ethyl acetate; ethanol) created by cleaning operations, the plant's scope of functions included self-sustaining continuous 24 hr operation. Both companies decided for an ASC series plant, equipped with high performance steam heating systems. Connected directly to the flexo printing presses, the plants are designed for the recovery of solvents with a 3% degree of soiling. Because of the various amounts of soiled solvents at each company, different types of ASC plants were installed.

Anton Debatin decided to go for the ASC-150 solvent recovery plant. This is the smallest vacuum distillation plant of the ASC series and is supplied with two stainless steel tanks with a capacity of 1000 litres each for soiled and clean solvent respectively. It is fed by an eight-colour *Fischer & Krecke Flexpress 6S-8 CI* flexo press. The press is provided with two pairs of

Left:
At Debatin, the Fischer & Krecke Flexpress 6S-8 flexo press prints PE films for the manufacturing of envelopes.

Right:
Each day, the ASC-150 solvent recovery plant installed at Debatin distils 250 l of soiled solvent.



150 litre containers (one for four print units) containing distilled fresh and soiled solvent respectively, all of them directly connected with the *ASC 150* plant via a pipe system. On average, 250 litres of soiled solvent is recovered each day.

Subsequent to the automatic cleaning process on the flexo press, the solvent containing ink residues initially is pumped into the appropriate container. When reaching a certain variable adjustable filling level, the soiled solvent is fed via the piping system into the appropriate tank and from there into the distillation vessel. The cleaned solvent is fed back from the storage tank into the container on the press by using a double diaphragm pump.

Leeb uses an *ASC-500* recovery plant for the continuous processing of soiled solvent from five eight-colour flexo printing presses. These are an *Uteco Opal 810* and a *Windmüller & Hölscher Novoflex*, both used for film printing, and a *Krönert Neoflex* inline press for printing Aluminium foil. Running in three-shift operation, these presses create an overall daily volume of more than 1000 litres of soiled solvents. Unlike the *ASC-150*, the storage tanks are not positioned alongside the plant but in a separate room. However, they are connected with the plant via a stainless steel pipe system.

A high standard

As far as design and functionality is concerned, both *ASC* models are identical. At the core of the explosion-proof recovery plant is the integrated steam heating system which only needs electric power to run. It facilitates higher distillation rates compared to conventional thermal oil systems, and faster heating of the soiled solvent and does not require the thermal oil to be changed. All *ASC* evaporators stand out due to continuous filling,

high capacity and high manufacturing quality. In this context, *OFRU*'s long experience with the construction of evaporators and process engineering for the distillation of flammable solvents is invaluable. *ASC* agitator evaporators are among the worlds' safest plants for solvent recovery which is approved and confirmed by Germany's Technical Control Board (*TÜV*).

Significant advantages

Compared with thermal oil systems, the steam heating system integrated into the *ASC* plants offers some distinct advantages. The solvent is heated much faster and no oil exchange is necessary, which drastically reduces maintenance costs. Steam heating prevents incrustation of the heating elements which ensures constant heating power and no oil sludge occurs in the machine. Due to the closed system, any corrosion of the vessel caused by air moisture within the thermal oil jacket is avoided.

The distillation vessel and its functions

A particular characteristic of the *ASC* plants is the stainless steel conical distillation tank, supplied with a double jacket with an integrated steam heating system. The steam transfers the energy extremely quickly into the solvent; at the same time a high distillation rate is achieved with only a small vessel volume. A safety valve limits the maximum pressure in the vessel to 0.5 bar (7.251885 psi), whereas the maximum pressure in the heating double jacket is limited to 10 bar (145.0377 psi). The over-pressure piping is placed at the back of the machine.

A vacuum system sucks the soiled solvent into the evaporator depending on the filling level. During the automatic distillation process the level of the distillation tank



The ASC-500 solvent recovery plant distils soiled solvent caused by three flexo printing presses.

remains constant, whereas the evaporated quantity of solvent will be replaced by an automatic feed system. The filling level of the *ASC-150* at *Anton Debatin* is automatically maintained at 75 litres of soiled solvent with the parameters of the auto mode operation changeable at any time. This machine can be used for 24 h operation. A temperature safety thermostat facilitates the variable adjustment and control of customer specific temperature settings for heat, steam and distillation.

Unlike comparable competitive products the steam heating system is not installed at the bottom but within the conical vessel. Hence the soiled solvent is heated across the entire filling level. Designed for a maximum solvent temperature of 185 °C (365 °F) and a pressure of 10 bar (145.0377 psi) it only requires electrical power for running.

Soiled solvents (organic or aqueous) are evaporated and then condensed, which ensures high separation efficiency. They are filled into the vessel either by hand, pump or vacuum, which features a double jacket with integrated steam heating system for indirect warm-up of the soiled solvent. Reaching the boiling point it begins to evaporate and the solvent steam flows through the condenser, where they are liquified. The viscous pollutants remain in the vessel and can be

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discharged easily, which reduces disposal costs. As the distillation takes place under vacuum conditions, the boiling point drops about 50% which considerably lowers the energy consumption of the ASC plants. The clean solvent is continually fed into the respective storage tank. The distillation capacity of the ASC-150 at *Anton Debatin* is about 30 l/h, whereas the system at *Leeb* processes 100 l/h. The capability generally depends on the type and degree of soiling of the solvents and the operation pressure.

Sump distillation and drainage

If the tank for soiled solvent is empty, the plant switches automatically to microprocessor controlled »sump distillation«. The continuous feeding is stopped and the remaining sludge in the vessel is evaporated to a viscous concentrate. During the sump distillation mode, the remaining residue will be concentrated to the desired viscosity. As soon as the control lamp indicates the end of the process, the flowable residues pass a cool-down period. Afterwards the plant switches off and is ready for manual or fully automatic drainage. In case the plant is extended with an optional housing with an exhaust (suction) the system is also suitable for operation in a non-explosion proof environment.

A slowly running scraper agitator with automatic self adjusting scraper PTFE blades cleans the inside walls of the conical distillation



vessel. The drainage of the highly viscous deposits into a container is done by natural gravity through a pneumatic drainage valve at the bottom of the conical distillation vessel. At *Leeb* the valve automatically drains the deposits into a container positioned on defined load cells (weighing). Once a weight of 200 kg is obtained, the valve closes to avoid flooding; this condition is displayed to the operator. In contrast, at *Anton Debatin* the drainage is done manually every ten hours. Subsequently, the plant gets automatically refilled with soiled solvent and the continuous recovery process starts again.

Differing from competitors

With the NC-safety package for their distilling plants *OFRU* differs from many of its competitors as they do not offer such an important module or do not integrate it into their equipment. For the distillation

of inks and varnish containing nitrocellulose pigments and solvent mixtures, the German Employers' Liability Insurance Association for the chemical industry (*Berufsgenossenschaft Chemie*) enacted special regulations to ensure the safe distillation of such components. When exceeding a pre-selected safety temperature in the residue (e.g. 120 °C/248 °F) a sprinkler system is automatically activated in the distillation vessel in order to stop the inflammation of the nitrocellulose. During this the vessel is flooded up to a certain height.

Conclusion

Leeb and *Anton Debatin* are two out of more than 100 customers worldwide who decided to go for a fully automatic ASC solvent recovery plant for the distillation of soiled solvent. The explosion-proof plants stand out due to their mature engineering, high manufacturing quality (piping and vessel made of stainless steel) and space saving compact design. In close cooperation with their customers, *OFRU Recycling's* highly specialised expert staff develops individually shaped plant concepts. The company also offers unique after-sales service, which is impressively proved through the installations at *Anton Debatin* and *Leeb*.

- www.debatin.de
- www.leeb.de
- www.ofru.com

Deployed for package film printing: The Opal (Uteco, left) and Novoflex (Windmüller & Hölscher) flexo printing presses.

Packaging converter with long tradition

Founded in 1928 by GEORG LEEB, the company initially focused on the supply of Aluminium foil for the dairy industry. Family-owned for three generations, the company currently has a workforce of 180 people. Today, *Leeb* is one of the leading manufacturers of flexible packaging in Germany. In addition to Aluminium foil they also process films and paper and a wide product range including bread bags, films for confectionary, technical films, wrappers for butter and cheese and yoghurt lids.

The envelope specialist

Starting in 1923 with the production of paper bags and pouches *Anton Debatin GmbH* continuously expanded their product portfolio. Then in 1953 the company switched to Polyethylene and subsequently adapted their policy to the respective market trends. Today *Anton Debatin GmbH* is one of Europe's leading manufacturers of environmentally sound tamper-evident security bags (*Debasafe*) and self-adhesive document envelopes.