NITROGEN IMPROVES THE QUALITY OF RESIDUAL-CURRENT DEVICES

CASE STUDY

NITROGEN GENERATOR IMT PN 8820 PAN ECOTUBE SUPPLIES 40 NM³ NITROGEN PER HOUR TO THE SOLDERING AND WELDING SYSTEMS AT DOEPKE SCHALTGERÄTE GMBH

Doepke Schaltgeräte uses various soldering and welding processes in the production of residual-current devices. The nitrogen (N_2) required for such processes is produced by an INMATEC nitrogen generator directly on-site at the plant. The self-generated nitrogen not only reduces costs, but also improves the quality of the electronic components installed.

The Inmatec container solution is located outside the factory floor.

Residual-current devices are used to protect persons against electric shock and to prevent electrically-ignited fires. For example, residual-current devices (RCD) switch the power supply off immediately in the event of dangerously high residual currents occurring. This could be the case if a person touches an electronic device which does not have proper insulation. The RCD measures the incoming and outgoing current in a circuit to this end. The current flow is interrupted if there is any difference. Due to increased safety standards, RCDs must now be installed in all socket circuits in new buildings. For Doepke, founded in 1956, the quality of the sensitive electronic components is thus the top priority when producing life-saving RCDs.

Air-tight tunnel wave

Small printed circuit boards are installed in the RCDs that Doepke produces for example. These flat modules, already fitted with SMDs (surface-mounted device), are connected with wired electronic components at the company's plant in Norden. A SEHO tunnel wave has been performing this task as of late. The THT components (e.g. connectors and switches), which are fixed in place by means of through-hole mounting, are firmly connected to the printed circuit board via a solder wave of liquid solder. The process takes place in an air-tight tunnel, which is filled with an artificial atmosphere of nitrogen to stop the soldered joints coming in contact with oxygen and to prevent oxidation. The new Inmatec nitrogen generator arrived at the plant at the same time as the new tunnel wave.

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By using nitrogen, lead-free tin alloys with antioxidant properties can now be used as solder, which enable shiny soldered joints in the same way lead does. It was also possible to reduce the solid content of the fluxes used, which provide better wetting of the pieces to be joined with the solder, from 3.5 percent to 1.2 percent thanks to the N2 protection. Since then, the printed circuit boards, which previously had residues in the form of a sticky coating, have no longer required time-consuming cleaning after the soldering process.

There is a summation current transformer at the core of the RCD, which consists of at least one current-carrying phase conductor and one neutral conductor (primary windings). These are surrounded by a toroidal core. If a residual current occurs and said current exceeds a certain value (rated residual current), a magnetic flux is generated in the toroidal core which induces a voltage in a 'secondary winding'. This secondary current triggers a switching lock via a holding magnet tripping device, which interrupts the circuit. Two selective soldering systems are used to solder the primary windings at the plant. In these systems, the windings are firmly connected to the switching unit using a soldering nozzle that discharges solder. The connection is made under a constant flow of nitrogen, which stops oxygen from coming in contact with the soldered joint and prevents oxidation. The EBSO systems, which are normally used for the THT mounting of printed circuit boards, were specially converted according to Doepke's specifications for this purpose. A decision that has paid off. The primary circuits were previously soldered by hand, one by one. With the new process and the addition of nitrogen, dross formation is now avoided, while solder and flux consumption is reduced. Improved soldering quality and drastically reduced rework and repairs are the result.

The IMT PN 8820 PAN EcoTube nitrogen generator has a large touch control panel for monitoring and controlling all operating values. In addition, the generator can also be maintained remotely using state-of-the-art remote management technology.

Laser welding with N_2

Laser welding is a further field of application for nitrogen. The magnets are combined to form magnet systems in a modern Trumpf laser welding machine. These are used in the holding magnet tripping device and, consequently, in a highly safety-critical position of the RCD, as this controls the RCD's tripping behaviour. Here, nitrogen is used both as a process gas and as an inert gas. In this way, it helps produce high-quality connections and prevents unwanted chemical reactions with oxygen, such as corrosion and burns.No nitrogen is required during this time. In contrast, in the production of large batches, production runs without interruption and a large amount of nitrogen must be made available contin-uously. By combining the various technical measures, efficiency could be increased and significant energy savings achieved.

The nitrogen is produced by a nitrogen generator of type IMT PN 8820 PAN EcoTube, which is housed in a container right next to the fac-

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Above left: An N_2 buffer tank is also located next to the nitrogen generator in the container.

Above right: Two selective soldering systems are used to solder the primary windings at the plant. In these systems, the windings are firmly connected to the switching unit using a soldering nozzle that discharges solder.

Right: In the N_2 tunnel the THT components (e.g. connectors and switches), which are fixed in place by means of through-hole mounting, are firmly connected to the printed circuit board via a solder wave of liquid solder.

tory floor. This generator supplies 40 Nm^3 nitrogen per hour to the soldering and welding systems, which run in two-shift operation. The nitrogen generator is equipped with pressure swing adsorption (PSA) technology, in which sterile compressed air flows through several tubes filled with a carbon molecular sieve. Together with novel block valve technology, they make it possible to generate more nitrogen with less compressed air. Up to 45 percent of the compressed air and the associated energy costs can be saved in this way. Oxygen and carbon dioxide molecules from the ambient air are caught in the sieve, while the free nitrogen molecules flow into the product tank. The dry nitrogen with a purity of 99.995 percent is pressed into the nitrogen network where it can then be used in various applications.

„With over 330 employees, we produce innovative solutions to enable the safe use of electricity. To ensure that this is possible, production processes must be optimised so that our products are always of the highest quality. Nitrogen plays an important role in many of our production processes. The Inmatec solution for on-site nitrogen generation is extremely reliable and exactly meets our needs. The costs were also a major factor in our selection. The price of the self-generated nitrogen, including the requisite compressed air, is far below the cost of a tank or cylinder bundles for our consumption needs. The investment is paid off after just a couple of years. We also do not need to worry about consumption or the delivery times for cylinders“, says Udo Ahrends, plant manager of Doepke Schaltgeräte in Norden.

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