

ZeroFlow[®] nitriding at automotive plant saves 140 metric tons of ammonia while producing a million gears per year with 99% process reliability and 98% equipment availability

A global automotive manufacturer specializing in the production of diesel engines for trucks, buses, construction machines, boats and other industrial applications decided to modernize and relocate the engine gear manufacturing cell that focused on mechanical assembly and heat treatment.

Situation Analysis

Previously, the heat treatment process step was carried out with the use of traditional gas nitrocarburizing technology in a 30+ year-old pusher furnace with oil bath cooling in a mixture of endothermic atmosphere and ammonia. The traditional technology and equipment no longer met the current specifications for quality, reliability, productivity, energy intensity, environmental protection and safety. The process had a variety of operational problems to be solved: frequent breakdowns, unreliable process control, instability of parameters and results, requirement for washing parts after oil cooling, requirement for chemicals, the need for constant monitoring by operators and maintenance personnel, storage and use of large amounts of liquid ammonia, which is a highly hazardous, poisonous and explosive gas that posed a threat to the immediate surroundings, the factory and the town.

Application

SECO/WARWICK supplied nitrocarburizing technology utilizing the **modern ZeroFlow[®] method** in retort-style batch furnaces in 2013 (Fig. 1.). The scope of the installation was a completely automatic thermal treatment line, for the production of the whole series of gears being manufactured. The line includes (5, soon to be 6) retort furnaces for nitrocarburizing, (1) four-chamber vacuum washer, (2) furnaces for activation in air, (2) units for further cooling down of the charges, and an automatic loader which ensures transport within the system (Fig. 2.). It is divided into two halves, which are independent in their operation and production, making it possible to plan



Fig. 1 Picture of the nitrocarburizing system at work

schedules of production and maintenance flexibility. The line is completely automated and self-operating (with safety monitoring), with charges loaded and unloaded by a robot. The working space of the system is 800/800/1500 mm (W/H/L) and gross mass up to 2000 kg that enables the customer to reach the productivity as high as 1000 kg of gears per hour.

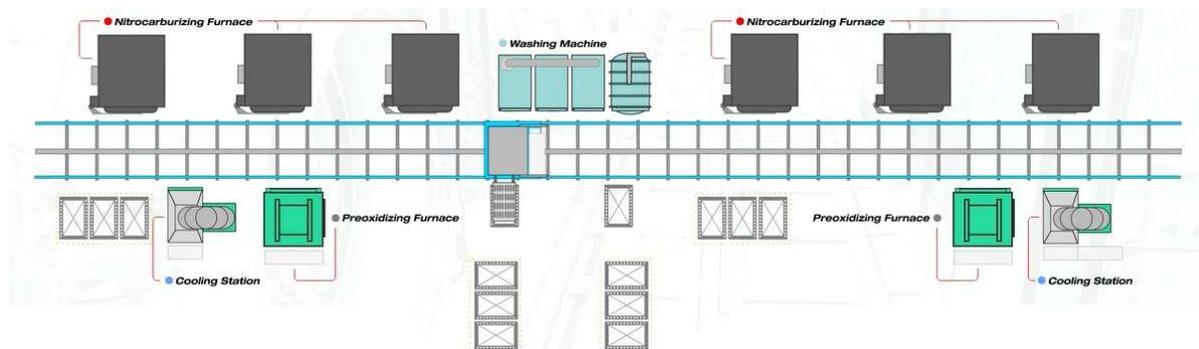


Fig. 2 Schema of the nitrocarburizing system

The system uses SECO/WARWICK's proprietary **ZeroFlow[®] technology**, which enables precise control of the nitrocarburizing process, using the minimum quantity of ammonia, while the carbon-carrier medium comes from methanol, which eliminates the need for connecting the endothermic atmosphere, methane, propane, CO or CO₂.

Process & results

The new system went online in 2014 and is currently operating at full capacity, meeting the stringent requirements for the automotive industry. It has reached the planned production goal of 1 million gears/year with 99% process reliability and 98% equipment availability. It works continuously with one maintenance break a year. The quality of the heat treatment results meets the requirements in terms of the thickness and hardness of the hardened layer, the compound layer and porosity. No deficient gears were found during normal operation. Moreover, fatigue properties have been improved by about 50 %. The line has achieved very good operation parameters: **the consumption of ammonia was reduced 8 times** the previous amount, from 160 metric tonnes/year to 20 metric tonnes/year. At the same time, **only 1 m³ of methanol** is used in exchange for the total elimination of fuel and process gases (methane, propane). A considerable achievement of the system was that the unit cost of heat treatment was reduced significantly. With all these benefits, there are no environmental, safety-related, emission of hazardous gases (NOx)



Case Study

issues, due to the ZeroFlow[®] method and the system of utilization of by product gases applied.

By choosing to employ the **innovative ZeroFlow[®] method**, the global company together with SECO/WARWICK have taken the lead in the application of nitriding and nitrocarburizing technology in the automotive industry, focused on quality, efficiency and environmental protection.

About SECO/WARWICK

The SECO/WARWICK Group provides industrial metal heat treatment furnaces used in a variety of processes for material finishing and component manufacturing applications. We supply furnaces to customers involved with steel, titanium and aluminum production as well as aluminum recycling, forging, automotive, aerospace, commercial heat treating, HVAC/R, electronics, wind energy, medical equipment and nuclear industries.

The SECO/WARWICK Group produces vacuum furnaces, atmosphere furnaces, controlled atmosphere aluminum brazing furnaces (CAB), aluminum process furnaces and vacuum metallurgy equipment in manufacturing sites in Poland (SECO/WARWICK Europe), the United States (SECO/WARWICK Corp., RETECH Systems LLC), India (SECO/WARWICK Allied Ltd.), China (SECO/WARWICK RETECH Mfg. Tianjin Co., Ltd.) and Brazil (SECO/WARWICK do Brasil Ltda.). Sales, service & spare parts offices in Germany (SECO/WARWICK Services GmbH) and Russia (SECO/WARWICK Russia) complete the worldwide customer care network. Visit our website below for more information.