NITRIDING FOR THE AUTOMOTIVE INDUSTRY

SECO/WARWICK

ZEROFLOW®

CASE STUDY 2022

www.secowarwick.com

Nitriding - the first choice for the automotive industry

ZeroFlow® nitriding at automotive plant saves 140 metric tons of ammonia and eliminates the consumption of tens of thousands of cubic meters of natural gas while producing a million gears per year with 99% process reliability and 98% equipment availability.

A global automotive manufacturer specializing in the production of 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, the requirement for washing parts after oil cooling and 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 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 productivity as high as 1000 kg of gears per hour.

Fig. 1 Picture of the nitrocarburizing system at work

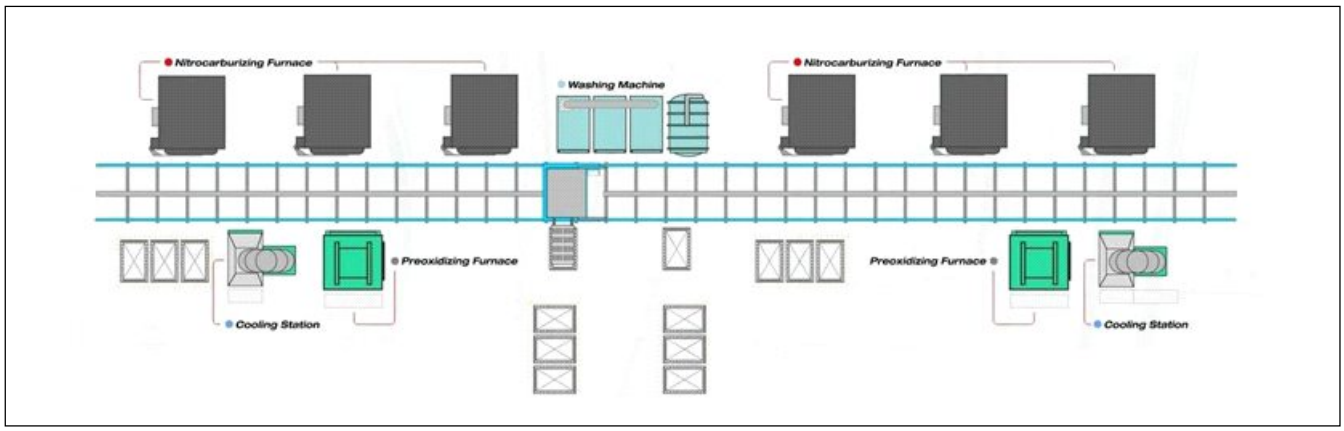

Fig. 2 Schema of nitrocarburizing system

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 Co_2.

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 tons/year to 20 metric tons/year.

At the same time, **only 1 m^3 of methanol** is used in exchange for the total elimination of fuel and process gases (methane, propane).

CASE STUDY

The ZeroFlow® ferritic nitrocarburizing process creates an effective case depth of c.a. 0.45 mm in approx. 8 hours. ensuring high accuracy and repeatability of results, including the compound layer, porosity, and hardness. At the same time, using the minimum amounts of utilities: approx. 500 kWh of electricity, 4 kg of ammonia, 0.2 kg of methanol, and 16 kg of nitrogen per 1000 kg net charge, which per 1kg of parts takes 0.5 kWh, 4 g of ammonia, 0.2 g of methanol, and 16 g of nitrogen.

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) issues due to the ZeroFlow® method and the system of the 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.