Gas Nitriding

using a ZeroFlow® method

ZeroFlow®

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SECO/WARWICK in cooperation with Professor Leszek Małdziński from the Institute of Work Machines and Vehicles of the Technical University in Poznan has developed a new method of controlled gas nitriding and nitrocarburizing - ZeroFlow®. In the gas nitriding methods, used so far, the process based upon the adjusted double-component atmospheres $NH_3 + NH_3$ dissociated and $NH_3 + N_2$ is used.

"Even though nitriding of steel can be considered a by-product of the dissociation of ammonia, there is no need to dissociate more ammonia than absolutely necessary. Zero flow nitriding is the first gaseous process that economizes the use of resources without compromising the added value to your product. It allows a targeted treatment of your components, independent on whether you do or do not want a compound layer. Zero flow nitriding gives you larger flexibility, better control and lower cost of your nitriding process."

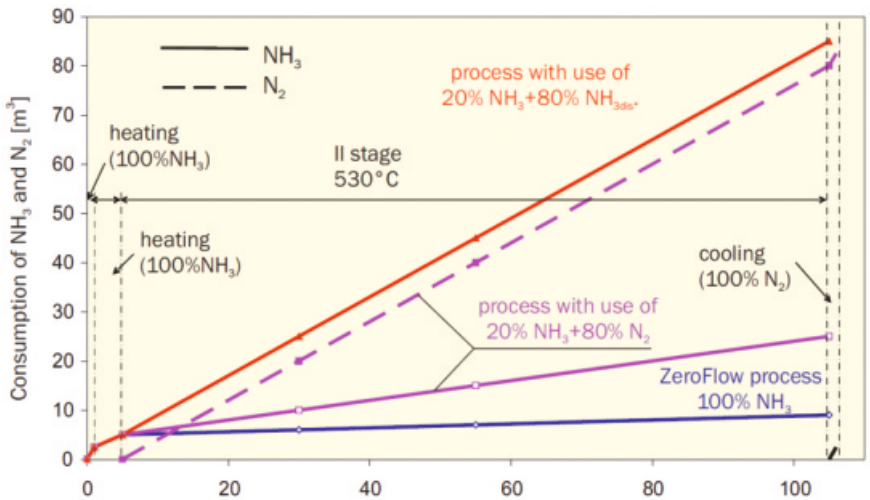
Professor Marcel A.J. Somers, Technical University Denmark

Marcel A.J. Somers

The ZeroFlow® method, developed by us, is based upon performing the nitriding process with use of only a single-component atmosphere – raw ammonia (NH_3). The adjustment of nitriding atmosphere chemical composition, and therefore the control of nitriding potential Np, is performed only by temporary stop and reactivation of NH feeding into the furnace. The amount of NH_3 fed into the retort is adjusted and controlled with use of a gas analyzer (NH_3 or H_2). Experimental research has shown that the ZeroFlow® method is characterized by much lower consumption and emission of gases, requires a simpler control system and allows for forming the layer phase structure with the same precision as in processes with double-component atmospheres.

Advantages of nitriding using a ZeroFlow® method

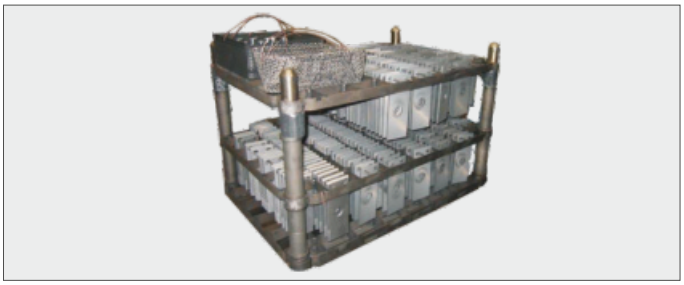
- Minimum consumption of operational gases; only raw ammonia
- Simplified gas system
- Safety
- Optional – process of nitrocarburizing and postoxidation and sulfonitriding
- High accuracy of forming the nitrided layer due to precise control and equilibrium character of the process
- The process is fully controlled by feeding only ammonia, along with the flow stops – ZeroFlow®
- The lowest consumption of the flushing gases due to the vacuum emptying of the retort
- Quick and precise atmosphere analysis on-line in the closed system, no sampling installations required
- Low investment costs
- Low operational costs
- Totally alternative solution to traditional methods of gas nitriding of steel



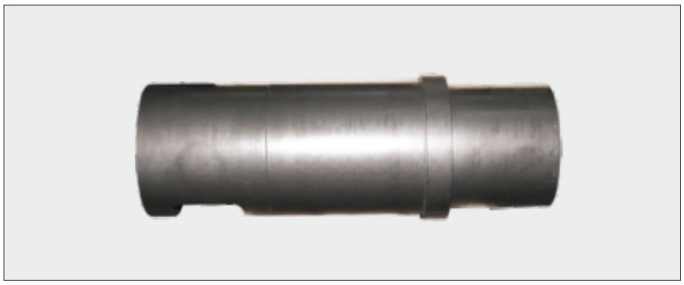
Consumption of NH_3 and N_2 in processes with use of double-component atmospheres ($NH_3 + NH_3$ diss. and $NH_3 + N_2$) and ZeroFlow®

Examples of parts nitrided with use of ZeroFlow® method

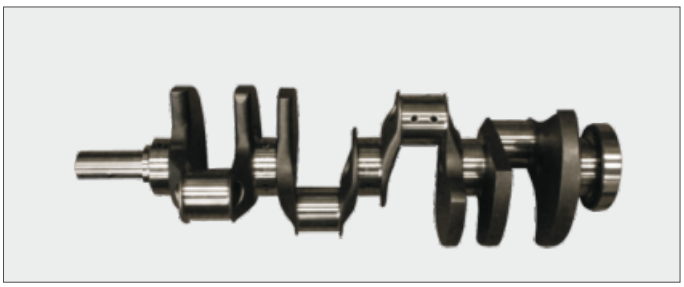
Nitriding of plates for casting glass bulbs for lamps



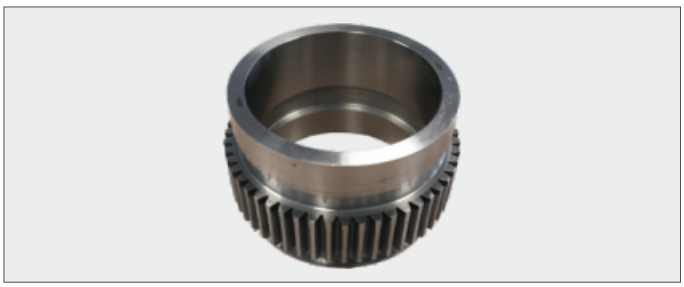
Nitriding of inlet sleeves with the pushing piston, used in molds for aluminium pressure die casting



Nitriding of crankshafts for engines of racing cars

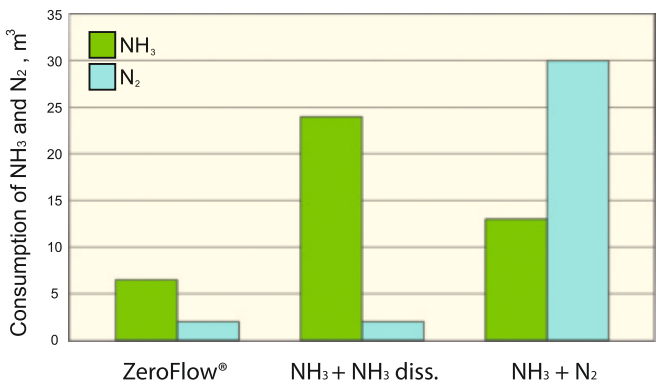


Nitriding of toothed wheels for wind power plants

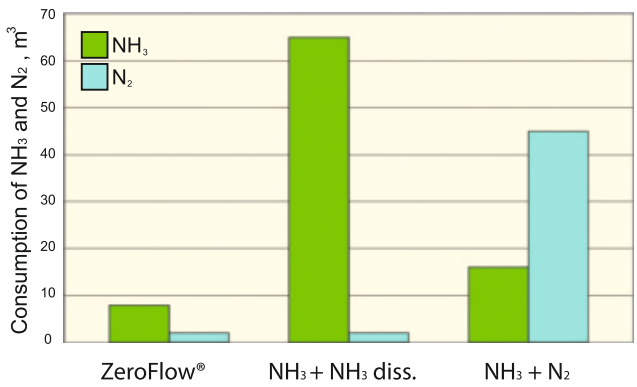


Nitrocarburizing and post-nitrocarburizing oxidation of shafts

Nitrocarburizing of piston rods in the automotive industry



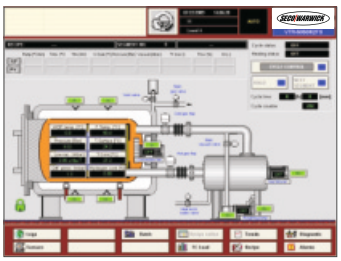
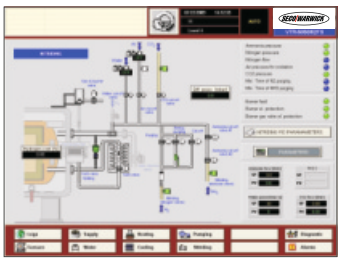
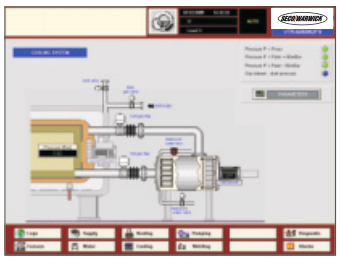
Comparison of consumption of NH_3 and N_2 in the traditional processes and ZeroFlow® during nitriding of a crankshaft made from steel 4340 (retort volume – 0.6 m3)



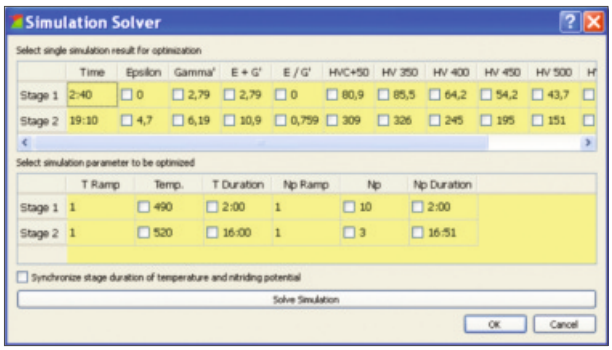
Comparison of consumption of NH_3 and N_2 in the traditional processes and ZeroFlow® during nitriding of wheels for wind power plants made from steel 31CrMoV9 (retort volume – 0.6 m3)

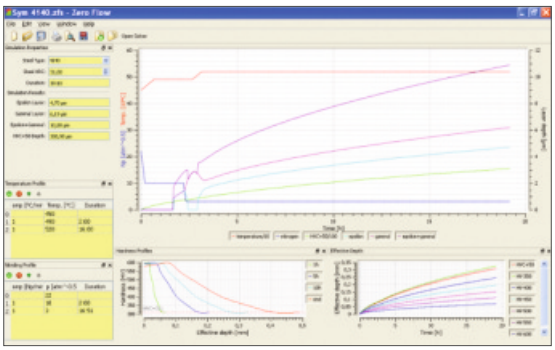
Control system properties

- All executive and measurement elements are reflected in the control system (PLC, SCADA), allowing for fully automatic diagnostics and localization of any machine operation anomalies
- Possibility of recording unlimited number of recipes, created by the process engineer
- All process data, presented as diagrams on the screen may be stored on the external hard disk or CD
- Possibility of exporting the historical and alarm data out of the system for further analysis (e.g. to .csv files)
- Logging of the most important historical data in files and/or any data base of the customer
- System of reporting the charges with a list of parameters and detail processing history
- UPS system, assuring proper system work, safety of operation and production technology
- Possibility of continuing the process after an interruption, resulting from e.g. power supply failure
- Specialized software, installed in the industrial computer (IPC), allows for remote monitoring and control of the furnace operation, optionally also through GSM network
- Set of service parameters, allowing for the device configuration from the visualization system level
- Work time counters for the executive elements – possibility of planning the periodic inspections
- Optional balancing of media: gases / water / energy / heat (range: total, process, user) with the supply source level control (tank level + alarms, tank filling)


- Optionally the control system may be equipped with software for reporting and advanced analysis of the historical data with use of prepared Word and Excel templates
- A wide offering of SECO/WARWICK solutions for gas nitriding includes modern tools that assist process designing An extended simulator of layer increase enables off-line programming and verification of accepted recipes
- Setting basic values of nitriding control parameters, namely temperature, nitrogen potential, as well as time enables to
- controlSetting basic values of nitriding control parameters, namely temperature, nitrogen potential, as well as time enables to control effects obtained in case of different steels that are available in program database.





- The program as a result of simulation provides information on the obtained phase structure, surface hardness, hardness layout and effective depth according to defined criteria. At present we work on next versions that will enable to program desired results, where the simulator will be responsible for determination of parameters that will ensure those results
- As an element of SECO/WARWICK furnaces control systems, the simulator will transmit a recipe directly to the furnace's controller to enable process start-up

Frequently asked questions

Does nitriding with the use of ZeroFlow® method obtain the same results as other nitriding methods.

Definitely yes. It is the nitriding method, based upon continuous adjustment of the nitriding potential, which assures obtaining proper structure of nitrided layers and the same results as in other nitriding methods. It has been confirmed in many industrial applications.

Does use of ZeroFlow® method allow for nitriding without creating the white layer of nitrides?

Definitely yes. That method, through proper adjustment of the nitriding potential allows for nitriding without creating the white layer. In many cases it has its use and allows for reduction of costs, connected with the finishing.

Is it possible to adapt your currently used furnaces with the ZeroFlow® nitriding method?

Definitely yes. In many nitriding furnaces there is no proper atmosphere adjustment. The gas system will be simplified, and ZeroFlow® method does not require using materials with high content of chromium and nickel on the internal equipment elements. It allows for reduction of costs of nitriding furnaces modernization and improving the nitrided layers quality.

What practical benefits are offered by ZeroFlow® method in relation to other methods?

- Reduction of ammonia and nitrogen consumption by several times in relation to the double-gas nitriding (ammonia + nitrogen or ammonia + NH_3 diss.) significantly influences on the reduction of the furnaceoperational costs
- Simple and automatic nitriding atmosphere adjustment by periodical addition of raw NH_3
- Simple operation and simplified gas system. No need of installing additional mass valve for nitrogen or dissociated ammonia, and in most cases no need of using the ammonia dissociator
- Creation of lower amounts of nitriding atmosphere allows for using a smaller atmosphere burner, which reduces the burner price and emission of harmful gases in to the atmosphere. It is environment-friendly nitriding and meets most urban requirements

The nitriding technology with ZeroFlow® method is based upon many years of research/trials and tests, documented and published in prestigious magazines about thermal processing.

They have been created by the eminent professionals from the science world and employees of SECO/WARWICK

For more information, results and documentation:
www.secowarwick.com


INDUSTRIAL EXPERIENCES WITH CONTROLLED NITRIDING USING A
ZEROFLOW METHOD

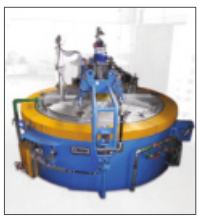
Concept of an economical and ecological process of gas nitriding of steel

Furnaces for gas nitriding

We use two basic types of furnaces for realization of adjusted gas nitriding: with the horizontal retort – type HRN and with the vertical retort (pit) – type VRN. The useful dimensions of the furnace chamber, load capacity and types of processes, which may be realized in the devices are adapted to the customers needs and requirements. In standard they are designed for the adjusted gas nitriding with use of ZeroFlow® method, but may be also used for other processes: nitrocarburizing, oxidation after nitriding and sulfonitriding, tempering and annealing in the nitrogen.

Modern, economical, ecological and simple in use! Why?

Due to use of important systems and features:


- Special sealing system of cover and retort (as in the vacuum furnaces)
- Vacuum system of removing air and remaining nitriding atmosphere from the retort
- Use of simple and adjusted gas nitriding with ZeroFlow® method by adjusting the nitriding potential (N_p), measuring the hydrogen content (% H) in the atmosphere, and by adding a small amount of raw ammonia
- System of accelerated charge cooling after nitriding
- Computer system of continuous adjustment and monitoring of the process parameters with the supervisory system
- The physically lowest possible ammonia consumption due to the periodic only ammonia dosage. It is used in the beginning of nitriding to create the nitriding atmosphere, and later to adjust the nitriding potential N_p
- Low nitrogen consumption, which is used only for the auxiliary operations: flushing of nitriding atmosphere and maintaining the overpressure during the charge cooling
- Simple system of utilization of process gases from the furnace, consisting of a small atmosphere burner

Join our customers

The reference list is available on demand. The reference list covers not only ZeroFlow® furnaces.
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