

TREATMENT OF ELECTROLESS NICKEL COATING**1. INTRODUCTION**

THE ELECTROLESS NICKEL COATING IS A WELL KNOWN CHEMICAL SYSTEM WITH THE MEDIUM LEVEL OF PHOSPHOROUS THAT IS SUITABLE TO OBTAIN ON ALL KIND OF PROCESSED SURFACES A UNIFORM AND CONSTANT LAYER, POROUS-LESS, ADHERENT AND BIG RESISTANCE AGAINST THE CORROSION AND FRICTION. THE RESULTING COATING IS A NICKEL-PHOSPHOROUS ALLOY OBTAINED BY AN AUTO-CATALYTIC BATH.

THE INDUSTRIAL USAGE OF THE ELECTROLESS NICKEL COATING HAS HAD A BIG INCREASE STARTING FROM THE SEVENTIES WHERE, WITH THE ADVENT OF SPECIFIC BRANDS HOW NIPLOY AND NICASIL, HAS ESTABLISHED AN IMPORTANT TECHNICAL POSITION IN THE FIELD OF SURFACE TREATMENTS. IN DETAIL, THIS TECHNOLOGICAL PROCESS, HAVE ALWAYS CAPTIVATED THE CUSTOMERS OF THE ENGINEERING SECTORS AND SO ON BY THEIR CHEMICAL AND PHYSICAL FEATURES. THE ELECTROLESS NICKEL COATING IS AS WELL SUITABLE TO PROTECT ALL SORTS OF METALS AND THEIR DERIVATIVES, THEN IT IS USEFUL FOR DECORATIVE PATTERNS BECAUSE OF THE AMAZING AESTHETICAL IMPACT. IN PARTICULAR, THE APPLICATION CONCERNS: IRON ALLOYS (PIG IRON, ALLOY STEELS, STAINLESS STEEL), COPPER AND ITS ALLOYS (BRASS AND BRONZE), ALUMINIUM ALLOYS.

THE MAIN INVOLVED SECTORS ARE THE FOLLOWING:

ALIMENTARY/PHARMACEUTICAL, AUTOMOTIVE,
ELECTRONICAL/TELECOMMUNICATIONS; PRINTS FOR RUBBER, PLASTIC AND
GLASS, PETROCHEMICAL, TEXTILE; PNEUMATIC; MECHANICAL;
AERONAUTICAL/NAVAL

MAIN PERFORMANCES:

HOMOGENEOUS COVERING ON ALL THE SURFACE OF THE IMMERSED PIECE
REDUCTION OF FRICTION
HIGH HARDNESS OF THE COATING
RESISTENCE AGAINST CORROSION
HIGH ADERENCE OF THE DEPOSIT

THE PERFORMANCES OF THIS KIND OF COATINGS ARE AFFECTED BY THE SURFACE OF THE BASIC SUBSTRATE, PROPORTIONED ON THE THICKNESS THEY REPRODUCE THE BASIC SUBSTRATES' FEATURES.

THEN THE RESULTING PERFORMANCES DEPEND ON THE THICKNESS AND ON THE THERMAL TREATMENT AS A SECOND STEP OF THE PROCESS. THE THERMAL TREATMENT INCREASES THE HARDNESS OF THE COATING FROM 500 HV100 (NOT HARDENED) UP TO ACHIEVE THE MAXIMUM OF 1000 HV100.

TREATMENT OF ELECTROLESS NICKEL COATING

THE ABSENCE OF THE ELECTRIC TRANSMISSION WHICH IS RESPONSIBLE OF THE COMMON PHENOMENA OF THE HYDROGEN DEVELOP ON THE ELECTROLYTIC-TREATED ITEMS, REDUCES THE WEAKNESS CAUSED BY THE NASCENT HYDROGEN ON THE SUBSTRATE.

THE HIGH CORROSION RESISTANCE IS MAINLY DUE TO THE CRYSTALLINE MORPHOLOGY ORIGINATED BY THE NICKEL-BASED PROCESS, IN FACT BECAUSE OF THE PRESENCE OF PHOSPHOROUS THE COATING PRESENTS LITTLE POROSITY. THE PROPORTIONED NICKEL ATOMS INDUCE AN HIGHER HARDNESS ON THE WHOLE SURFACE.

THE TREATMENT IS PROCESSED WITH REGARDS TO THE NORM UNI ISO 4527/2006.

2. GENERAL APPLICATIONS

THE PRESENT PROCEDURE IS SUITABLE TO ALL METALS AND ALLOYS THAT PRESENTS ELECTIC-CONDUCTIVITY PROPERTIES (THE ENC DOES NOT REACT ON ZINC ALLOYS).

IN PARTICULAR ON BOLTS, NUTS, ODDS AND ENDS AND ITEMS UP TO 2,5 METRES LONG.

THE PRESENT PROCEDURE IS PERFORMED WITH RESPECT TO THE NORM UNI-ISO 4527/2006.

3. CYCLE

SANDBLASTING(OPTIONAL): THE MICRO SHOT-PEENING IS NEEDED TO MAKE THE SURFACE HOMOGENEOUS WITH THE REMOVAL OF ABOUT 1 MICRON OF MATERIAL AND CREATE A LIGHTLY ROUGH SURFACE, SUCH AS TO FAVOR THE ANCHORAGE OF THE NICKEL LAYER WITH CONSEQUENT IMPROVEMENT IN TERMS OF ADHERENCE OF THE DEPOSIT.

MICRO SHOT-PEENING TREATMENTS ARE DIVIDED INTO THREE CATEGORIES:

- MICRO SHOT-PEENING WITH GRANINOX: PERFORMED BY MEANS OF TWO AUTOMATED MACHINES, IT IS SUITABLE FOR SHOT-PEENING OF STEELS IN GENERAL AND ALLOYS WITH LOW SURFACE HARDNESS;
- SHOTBLASTING WITH CORUNDUM CRYSTALS: MADE BY TWO WITH MANUALLY PROCESSED MACHINES, IT IS PARTICULARLY SUITABLE FOR PROCESSING HARDENED AND STAINLESS STEELS;
- SHOTBLASTING WITH CERAMIC BALLS: PERFORMED BY A MANUALLY OPERATED MACHINE, IT IS IDEAL FOR PROCESSING STAINLESS STEEL WITH HIGH AESTHETIC STANDARDS.

TREATMENT OF ELECTROLESS NICKEL COATING

AS A RESULT OF THE DIFFERENT TREATMENTS, BOTH FOR STANDARD ADJUSTMENT STARTING SURFACES AND FOR THOSE WITH EXTRUSION ROUGHNESS, THE DEGREE OF SURFACE ROUGHNESS, MEASURED IN RA, AS A RESULT OF MICRO SHOT-PEENING IS SET ON VALUES OF ONLY ABOUT 1,6

CHEMICAL-CLEANING: THIS STEP CONCERNS THE ITEMS DIPPING IN A CONCENTRATED ALKALINE-BATH AT THE OPERATIVE TEMPERATURE OF 50-55°C FOR ABOUT 50 MINUTES, IN ORDER TO DEGREASE THE SURFACE AND ELIMINATE ALL THE POLLUTING ORGANIC COMPOUNDS (THE TIME IS STRICTLY RELATED TO THE AMOUNT OF GREASE-OIL ON THE GOODS).

PICKLING: TO ELIMINATE THE PRESENCE OF INORGANIC OXIDES ON THE ITEMS' SURFACE THIS STEP BECOMES INDISPENSABLE. THE BATH CONSISTS IN A SOLUTION OF CHLORIDRIC ACID WHERE THE ITEMS MAY STOP FOR ABOUT 30 MINUTES DEPENDING ON THE AMOUNT OF OXIDES ON THE SURFACE. HOWEVER THIS STEP CAN BE EVEN AVOIDED IF THE SURFACE DOES NOT PRESENT ANY OXIDES.

RINSING: THE RINSING STEP ALLOWS TO NEUTRALIZE THE SUPERFICIAL pH THEREFORE WITH A NEUTRAL pH THE REACTIONS ON THE SURFACE ARE MORE EFFICIENT AND IT ALLOWS TO AVOID THE POLLUTION BETWEEN DIFFERENT CHEMICAL BATHS. IT IS PERFORMED BY A WATER-FLOW COMBINED WITH AIR-BUBBLING FOR AT LEAST ONE MINUTE.

ACTIVATION: IS THE PROCESS OF DIPPING IN A NEUTRALIZING ACID BATH TO ACTIVATE THE SOSTRATE POROUSNESS.

ELECTROLESS NICKEL COATING: IT IS THE ELECTROLESS DEPOSITION OF A PROTECTIVE NICKEL ON A SURFACE THROUGH AN AUTOCATALYTIC REACTION OF THE PHOSPHORUS-NICKEL ALLOY. MORE IS THE PHOSPHORUS ON THE ALLOY MORE IS THE CORROSION RESISTANCE (LESS POROUSNESS). THE PROTECTIVE FILM GUARANTEES THE CORROSIONS' RESISTANCE WHEN IT APPEARS HOMOGENEOUS AND THICK ENOUGH (MINIMUM THICKNESS ADVISED IS 10 MICRONS) BECAUSE IT PROTECTS THE ITEM AS A CATODIC PROTECTIVE FILM. THE TEMPERATURE IS MANTAINED AT 85°C. THE BATH MONITORED BY A PROCESS SERVICE AND THE GOODS ARE FREQUENTLY CONTROLLED BY THE THICKNESS TEST, BY THE ADHERENCE TEST AND BY THE SALT-FOG CABINET TO CHECK THE CORROSION RESISTANCE.

TREATMENT OF ELECTROLESS NICKEL COATING

HEAT TREATMENT(OPTIONAL): THE CHEMICAL NICKEL LAYER IS TREATED AT HIGH TEMPERATURES TO OBTAIN A CERTAIN COMPACTNESS OF THE FINAL LAYER, IMPROVING ITS ADHERENCE, AND TO INCREASE THE LEVEL OF SUPERFICIAL HARDNESS. THE METALLIC DETAIL, AS SOON AS IT IS TREATED, HAS A STANDARD SUPERFICIAL HARDNESS OF ABOUT 500 HV100. THE SITUATION OF THE CRYSTAL LATTICE, AS SOON AS THE LAYER IS PLACED, IS NOT STABLE AND IT IS CALLED A-NICKEL (COMPACT HEXAGONAL CRYSTAL SHAPE). THANKS TO THE HEAT TREATMENT IT CAN TRANSFORMED TO B-NICKEL (FACE-CENTRED CUBIC SHAPE), WHICH PRESENTS A MORE STABLE COMPOSITION AND A HIGHER SUPERFICIAL HARDNESS (ABOUT 1000 HV100). IN GENERAL, TO OBTAIN A SURFACE HARDNESS OF 1000 HV100 A HEAT TREATMENT OF 10 HOURS AT 300° C IS ENOUGH OR, ALTERNATIVELY, 1 HOUR AT 400° C. BEFORE STARTING THE HEAT TREATMENT, ANYWAY, THE DEGREE OF DEFORMATION OF THE BASIC MATERIAL HAS TO BE TAKEN INTO ACCOUNT .

SEALING (OPTIONAL): IN ORDER TO OBTAIN A BETTER PRODUCT TO RESIST MORE AGAINST THE AGRESSIVE AGENTS THIS STEP BECOMES FONDAMENTAL. IT IS PERFORMED THROUGH AN ITEM-SOAKAGE INTO EMULSIFYING OIL OR CRUDE OIL.

CORROSION RESISTANCE (UNI EN ISO 9227/93)

ENC on sandblasted samples (Roughness 1,6-2,0 Ra)

Thickness (µm)	No seal	R-68	R-80	R-100
10	6 hours	48 hrs	72 hrs	96 hrs
20	10 hours	60 hrs	96 hrs	168 hrs
50	24 hours	96 hrs	168 hrs	>312 hrs