# ABSTRACTS OF PAPERS IN ENGLISH

## EFFECT OF TRANSIENT LIQUID PHASE DIFFUSION BONDING ON MECHANICAL PROPERTIES OF AISI 304 STAINLESS STEEL

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**Abstract**

AISI 304 stainless steel is joined by transient liquid phase diffusion bonding, using an amorphous base nickel interlayer with a thickness of 50$\mu$m. The bonding process was carried out at 1100°$C$ under different atmospheres, air, argon and vacuum, at different bonding times of 30 to 180 min. The joints were then homogenized at 1150°$C$ for 120 min. Microstructure studies showed that voids and cavities were formed at the joint region and the joint/parent alloy interface of bonds made under air and argon gas. The formation of these voids and cavities was related to the oxidation of the interlayer and joint/parent alloy interface during the bonding process. But, there were no voids or cavities at the bond region and joint/parent alloy interface when the bonding process was carried out in vacuum. Shear test results showed that the shear strength of bonds made under vacuum and then homogenized is very close to the shear strength of the parent alloy.

## EFFECTS OF SOME ALLIYNG ELEMENTS ON CORROSION BEHAVIOR OF ND-FE-B SINTERED MAGNETS

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**Abstract**

The corrosion behavior of some Nd-Fe-B magnets is compared with a near stoichiometric $Nd_{12.8}Fe_{79.8}B_{7.4}$ alloy. The microstructure of magnets was characterized using a scanning electron microscope (SEM)

equipped with an energy dispersive X-ray (EDX) analizer. The corrosion behavior of magnets was studied at room temperature using an EG&G potentiostate analyzer in 0.01 and 0/1 molar $H_2SO_4$ solutions.

The results of EDX analyses show that the weight ratio of Transition-Metals to Rare-Earth elements could be an efficient criteria for recognizing the main $Nd_2Fe_{14}B$ magnetic phase in the structure of the magnets. By reduction of the Nd-rich grain boundary phase and/or substitution of some Fe atoms by Co, a vital improvement in the corrosion resistance of the magnets was observed, due to a decrease in the galvanic coupling effect between Nd-rich and $Nd_2Fe_{14}B$ magnetic phases.

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## EFFECT OF THERMOMECHANICAL PARAMETERS ON TEXTURE AND ANISOTROPY OF 90-10 BRASS SHEETS

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**Abstract**

Earing is often undesirable in the production of deep drawn cups, because it results in an nuniform cup height and additional scrap. It is known that the formation of ears is due to high planar anisotropy in the sheet and can be minimized by appropriate thermomechanical treatment. Thermomechanical parameters affect anisotropy by changing the microstructure and texture. In this work, the effect of finish rolling temperature, cold reduction and annealing temperature on texture development and microstrucure has been investigated. It is shown that uniform deformation at a higher finishing temperature is responsible for the formation of sharp Cube and G texture components. In contrast, mechanical twinnings are widely formed at low finishing temperatures. There is also a direct relation between the intensity of the Cube component and the amount of cold reduction. The lower planar anisotropy was observed in samples with uniform microstructure and without annealing twinning. Furthermore, in sheets with a balance between the rolling and annealing textures, lower earing was produced after deep drawing. The minimum amount of earing was obtained in samples with higher cold reduction and first annealing temperature and lower final annealing temperature.

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## THE USE OF ELECTROCHEMICAL NOISE IN SCC MONITORING OF S.S 304 AND BRASS ALLOYS

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**Abstract**

An investigation into the electrochemical noise generation during Stress Corrosion Cracking (SCC) of austenitic stainless steel 304 in acidified 25%$MgCl_2$ and 70-30 brass in Mattson's solution was conducted. Initiation and propagation of cracks in both specimens can be recognized from the fluctuations of potential and current. Nucleation of cracks in stainless steel 304 is accomplished with spontaneous jumps in both current and potential with slow recovery, while, at the final stage of failure, the intensity of fluctuations are so high.

In brass, sample initiation and propagation of cracks, is accomplished by spontaneous jumps of current and potential with non-complete recovery. The relation between potential and current fluctuations has been evaluated in the time domain and the obtained data has been analyzed in the frequency domain using Power Spectral Density (PSD). According to the obtained results, it was found that there are good relations between the current and potential noise caused by initiation and propagation of cracks during SCC, which may be used for SCC monitoring.

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## STABILITY ANALYSIS OF TUNNEL, PORTAL TRENCH AND UNSTABLE WEDGES OF THE TUNNEL IN THE SHENAGE 47+400 GHAZVIN-RASHT-ANZALI RAILROAD USING STEREONET AND COMPUTER SIMULATION

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**Abstract**
Observing authorized slopes in a railway makes the use of tunnels in mountainous areas inevitable. The tunnel on the 47+400 km of the Ghazvin-Rasht-Anzali railway path is being studied. The relevant location facing the Sefidrood River on the western part of the Alborz mountain range includes andesite and trachy-andesite rocks of the Eocene age. The track of the tunnel and its entrance trench lies among the jointed rock masses of thick layers crossed by a regional fault. Its exit trench lies on a series of alluvial sediments (Quaternary). The subject of this study also includes local slides in the slope level and the risk of landslides, which is a point of concern regarding the safety and security of the tunnel, as to the stability of the jointed rock mass on the entrance trench of the middle part of the tunnel.

The length of the tunnel is 490 meters and the maximum height of the overburden is approximately 150 meters with a relatively east-west trend. The results of geo-engineering surveys and statistical joint-graphics of stereograms reveal at least three discontinuity systems in the rock mass. Several tunnel sections along the tunnel were studied, in order to analyze the stability of rocky wedges inside the tunnel, as well as that of the entrance trench.

After finding the geo-mechanic constants and geometric specifications of the joints, the data were analyzed by the use of Unwedge Software in the inner part of the tunnel and a structural method for the entrance trench. The critical section with the highest overburden was modeled by Phase$^2$ software. The results show that in the aforementioned locations inside the tunnel and trench walls there are the risks of plane failure, wedge failure and toppling. The stable slope for the right side wall of the trench is 72 degrees and that of the left wall is 56 degrees.

One of the most important aspects of the railway tunnel is bottom settlement. Therefore, the authors have developed a new formula for determination of the maximum allowable bearing capacity of the rock foundation based on RMR. Results show that there is no problem in the tunnel stability in the settlement.

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## PREPARATION OF NANOPOWDERS AND THEIR EFFECTS ON THE PROPERTIES AND MICROSTRUTCTURE OF ZNO VARISTORS

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**Abstract**
In this research, after preparation of zinc oxide nanopowder via a high energy ball mill (SPEX) and evaluation of its particle size distribution, as well as morphology, by a zeta potential particle size analyzer and transmission electron microscopy (TEM), the samples were made and sintered at different temperatures. The physical and electrical properties were measured and the microstructure was studied by scanning electron microscopy (SEM). For determining the grain size distribution, X-ray diffraction analyses were also used. Finally, the I-V characteristics of the varistors were obtained with an I-V meter (Keithley 237). It was shown that by using nanopowders produced by high energy ball milling, the electrical properties of ZnO based varistors, such as breakdown voltage and the non-linear coefficient ($\alpha$), were enhanced, in comparison with micro powders. The non-linear coefficient ($\alpha$) was about 60 and breakdown voltage was about 5500 V/cm. The enhancement of the properties was related to the fine and homogeneous microstructures of the samples.

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## DETERMINATION OF STRAIN FIELD AND LATERAL SPREAD IN FLAT ROLLING OF WIRE USING NUMERICAL ANALYSIS

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**Abstract**
In this research, the combined Finite and Slab Element Method (FSEM) is used to analyze the flat

rolling of wire. The effective strain field of the copper flattened wire is calculated for different reductions in height and frictional conditions and the results are confirmed by performing the vickers microhardness measurements on a cross section of the flattened wire.

The FSEM and microhardness results show the minimum and maximum effective strains at the round edge and center of the flattened wire, respectively. Moreover, the lateral spread and width of the contact area are predicted by FSEM for different reductions in height and frictional conditions. A good agreement was found between the calculated and experimental results.

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## THE EFFECT OF MOLD VIBRATION ON THE MICROSTRUCTURE OF Al7075 THIXOFORMING BILLET PRODUCED BY THE COOLING SLOPE TECHNIQUE

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**Abstract**
The casting and forming of alloys in a semi-solid state have attracted progressive attention, both by researchers as well as industries, during recent years. A suitable semi-solid microstructure consists of globular grains in a matrix of lower melting point. Such a microstructure is produced by different methods, including the cooling slope technique.

In this work, as a new research, the combined effect of cooling slope angle and mold vibration on the semi-solid microstructures of Al7075 is assessed. The results indicate that the mold vibration decreases noticeably the average globule size of the alloy. Also, the effect of mold vibration increases with increasing the size of the primary crystals entering into the mold through the cooling slope. Moreover, it is found that the mold vibration improves the shape factor of the alloy globules after reheat treatment.

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## EFFECT OF HEAT TREATMENT ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF A LASER SINTERED LOW ALLOY STEEL

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**Abstract**
In the present work, the effect of various heat treatment cycles including annealing, normalizing, temper -hardening, and austempering on the microstructure and mechanical properties of a low alloy Ni-Mo-Cu steel produced by laser sintering was studied. It was shown that a homogenizing temperature above $1000°C$ is required to remove the heterogeneous microstructure of the low alloy steel after laser sintering. Meanwhile, austenitizing at 850-$900°C$ for 30 min followed by low-temperature austempering at $300°C$ or temper-hardening at $350°C$ was found to significantly increase the strength of the steel (about 50%) without deteriorating the hardness. A Further improvement in the mechanical properties was obtained when a combined heat treatment cycle composed of carbide dissolution at $1050°C$, normalizing in air, austenitizing at $900°C$, and austempering at $300°C$ was applied.

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## STUDY OF EFFECTIVE PARAMETERS ON CORROSION RESISTANCE OF PLASMA ELECTROLYTIC NITROCARBURISED 316L AUESTENITIC STAINLESS STEEL

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**Abstract**
A number of studies have been carried out on the use of plasma electrolytic nitrocarburising technology for the surface hardening of stainless steels for better corrosion resistance resulting from this technique. However, very few have focused on the optimization of the plasma electrolytic nitrocarburising process parameters. In this study, a design of experiment (DOE) technique, the Taguchi method, has been used to optimize the plasma electrolytic nitrocarburising, not only for surface hardening, but, also, for the corrosion protection of 316L austenitic stainless steel, by controlling the coating process's factors. The experimental design consisted of four factors; (Carbamide concentration, electrical conductivity of electrolyte, voltage and duration of process), with three levels of each factor. Potentiodynamic polarization measurements were conducted to determine the corrosion resistance of the coated samples and the results analyzed with related software. An analysis of the mean of signal-to-noise (S/N) ratio indicates that the corrosion resistance of plasma electrolytic nitrocarburised 316L stainless steel is influenced, significantly, by the levels in the Taguchi orthogonal array. The optimized coating parameters for corrosion resistance are 1150 g/l for carbamide concentration, 360 mS/Cm for electrical conductivity of the electrolyte, 260 Volts for applied voltage and 6 minutes for treatment time. The percentage contribution of each factor is determined by the analysis of variance (ANOVA). The results show that the applied voltage is the most significant factor affecting the corrosion resistance of the coatings.

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## ASSESSMENT OF THE INDIRECT RAPID TOOLING METHODS USING ANALYTIC HIERARCHY PROCESS (AHP)

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**Abstract**
It is well documented that Rapid Prototyping (RP) processes enable to speed-up the design and manufacturing steps in the production cycle. Recently, the application of RP processes in Rapid Tooling has been expanded and has become one of the most essential element of the manufacturing processes. Since a number of different RP processes are available, there is always a challenge in selecting a suitable method for the desired application at reduced cost and investment. In the present work, the AHP method was used to assess the applicability of indirect rapid tooling processes for Iranian industries. As a case study, the analysis was applied to the Iran-Khodro Engineering and Parts Design Manufacturing Company (SAPCO), Tehran.

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## EVALUATION AND COMPARISON OF STRAIN DISTRIBUTION IN THICK MICROALLOY AND PLAIN CARBON SHEET STEELS

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**Abstract**
Sheet metal forming has been developed as a common process of manufacturing, especially in the auto making industry. So, investigating this process for improving and optimizing it, in order to prevent defective production, is very important.

Due to the many advantages of microalloy steels, nowadays, plain carbon steels are widely replaced by microalloy ones in the auto making industry. In this research, the Dome Height Test method has been used for five types of sheet. The effect of lubrication has also been discussed here.

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## A NUMERICAL ANALYSIS OF THE ROLE OF IMPORTANT PARAMETERS IN THE GROUTING PROCESS IN DISCONTINUOUS ROCK MASSES

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**Abstract**

Grouting is widely used to improve in-situ soil/rock quality and, in this regard, various injection techniques have been developed. From a rock engineering point of view, penetration grouting (also called permeation grouting) is commonly used to fill the voids of the jointed rock mass so as to improve the rock stiffness and strength and reduce groundwater flow potentials.

The nature of grouting in rock is different from that of soil. Within a jointed rock mass, the intersection of pre-existing discontinuities forms a network of fractures that provide the grout penetration path. Therefore, the geometric properties of discontinuities play a significant role in the grouting process. Moreover, the grout penetration radius into the rock mass is a function of discontinuity geometry, grout characteristics and grouting pressure.

It is the intention of this paper to conduct a parametric analysis of the role of the above parameters on the grouting process. The Distict Element Method (DEM) was employed to carry out a comprehensive numerical analysis of the role of the important parameters mentioned above on the grouting process. The roles of all parameters were compared against one another and summarized in a diagram. The obtained results agree well with field observations, but, it is believed that further work is required, in order to be able to incorporate the numerical findings to actual field conditions.

## PETROLEUM ENGINEERING CALCULATION WITH FUZZY PARAMETERS

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**Abstract**

In this study, fuzzy arithmetic is presented as a tool to tackle the numerical solution of engineering problems with uncertain and imprecise model parameters. Fuzzy numbers and various methods of their implementation and processing are also discussed. As an example, a strontium sulfate scale mass, under oilfield conditions, is calculated by both crisp numbers and fuzzy ones. Solubility product, free sulfate concentration and scale mass are determined as fuzzy numbers and compared with ordinary results. Since fuzzy numbers consider the entire set of imprecise values specified, it seems fuzzy number based engineering calculations give more realistic and reliable results than those of crisp numbers.

## PROCESSING DEFECTS IN HOT POWDER EXTRUSION OF ALUMINUM MATRIX COMPOSITES

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**Abstract**

An overview of macroscopic and microscopic processing defects that can arise in hot powder extrusion of aluminum matrix composites is presented and their origins are discussed. Some of these defects include microcrack formation in the matrix, fir tree defect, piping, funnel formation and oxidation of matrix powders. Lubrication conditions, usage of aluminum cans, extrusion temperature and ram speed will affect the surface quality of the products.