VESTNIK

SARATOV STATE TECHNICAL UNIVERSITY

2023

№ 1 (96)

Scientific Journal

Since 2003

Published quarterly

March 2023

Constitutor and Editor
Yuri Gagarin State Technical University of Saratov

Editorial office: 25/615 77, Politechnicheskaya Street
Saratov, 410054 Russia
Phone: +7 (845-2) 99-89-81
E-mail: vestnik@sstu.ru

Print date: 24.03.2023. Date of publication 29.03.2023
Format 60×84 1/8 Offset-Print
Conventional printed sheet 11,5 Publication base sheet 3,6
Circulation: 500 printed copies Order 9
Publisher and Editorial Address:
77, Politechnicheskaya St., Saratov, 410054, Russia

Registration Certificate of mass media ***PI № FS 77-65155*** of *28 March 2016* issued by the Federal Service for Supervision of Communications, Information Technology, and Mass Media

eLIBRARY.ru

ISSN 1999-8341

CONTENTS

A.A. Ignatiev, E.A. Sigitov, V.A. Dobryakov

A SYSTEMATIC APPROACH TO SOLVING THE ISSUE OF QUALITY MANAGEMENT OF TURNING ON PRECISION AUTOMATED MACHINES

Abstract. *Based on the system approach, the article considers the methods of quality control of the turning technology using precision automation solutions that will minimize effects of the disturbing factors and control macro- and microgeometric precision parameters of the components.*

Keywords: *processing quality management, system approach, precision lathes*

D.V. Molchanov

INCORPORATING AN INTELLIGENT SUBMERSIBLE REFRACTOMETER INTO THE AUTOMATIC CONTROL SYSTEM OF THE GAS HEATER

Abstract. *The article deals with the structure of gas heaters, as well as the chemical properties of intermediate heat carriers and possibilities for using intelligent refractometers into automatic control systems in order to trace the chemical properties of intermediate heat carriers used to increase the service life of gas heaters.*

Keywords: *gas heater, coolant, propylene glycol, refractometer, ethylene glycol, diethylene glycol, automatic control system*

I.V. Golovchenko, D.Yu. Finogeev, O.P. Reshetnikova

ANALYSIS OF MECHANICAL PROPERTIES OF FILLED PHOTOPOLYMERS IN THE AREA OF ADDITIVE TECHNOLOGIES

Abstract. *The basic materials used in photopolymer printing and their applications are considered. and an overview of scientific works relating the study of mechanical properties of filled photopolymers is provided. In the conclusion the focus is made on the importance of conducting research in the given area due to a widespread introduction of additive technologies into machine building industry.*

Keywords: *additive technologies, filled photopolymer resins, photopolymer resins, mechanical properties, 3D-printing, machine building, DLP-printing*

O.V. Zakharov, A.S. Yakovishin, F.D. Suleymanova, A.V. Zhukov

APPLICATION OF ISO 16610 SERIES FILTERS IN THE SURFACE STRUCTURE ANALYSIS. PART 4. PROFILE SPLINE AND WAVELET FILTERS

Abstract. *The authors focus on the fourth article in the series devoted to application of the ISO 16610 series of standards applied for filtering profiles and surface textures. The article presents an analysis of profile linear, robust spline, and wavelet filters. A comparison is made with the Gaussian filters across five parameters. It has been established, that spline filters have a fast calculation algorithm, which allows them to be used for large amounts of data. The robust spline filter has an advantage over the Gaussian filter, as it eliminates end effects and does not require profile shape alignment. The wavelet filter is an ideal multiscale filter. Therefore, these types of filters expand the capabilities of standard Gaussian filters needed for the analysis of multifunctional surfaces.*

Keywords: *measurement, surface metrology, roughness, filtration, profile filter, spline filter, wavelet filter*

A.V. Panfilova

MECHANISM HIGHLIGHTS OF THE EDGE CUTTING TECHNOLOGY FOR MECHANICAL DESCALING OF METAL SURFACES

Abstract. *The article considers the key features of the mechanism implemented in a new edge cutting technology for mechanical descaling of metal surfaces. Theoretical dependences of increasing efficiency of descaling the surface on the ratio of the values of the pressing force of the tool to the workpiece, the friction force in the tool support, and the impact force of the scale on the tool are presented.*

Keywords: *scale, rolling, descaling method, device, tool, impact mechanism, efficiency of the method*

D.O. Churikov, I.V. Zlobina, N.V. Bekrenev

EFFECTS OF THE GAP SIZE WITH EXCITED ULTRASONIC VIBRATIONS ON THE LEVEL OF PROCESS LIQUID CLARIFICATION

Abstract. *Analysis of requirements for the purity of industrial liquids, as well as methods for their purification, is carried out. It is shown that among all the methods, filtration provides the highest degree of purification, though a number of problems still remain. The proposed solution to the problem includes a filter, where liquid passes through an adjustable gap with excited ultrasonic vibrations. Investigations of the effect of the gap size on the degree of liquid purification showed that the highest degree of purification is provided by a gap of 0,1 mm or less.*

Keywords: *purification methods, filtration, pollution, purity levels of liquids, ultrasound, cavitation, dispersion, gap*

S.Zh. Ibrokhimov, I.N. Ganiev, B.B. Eshov

HARDNESS AND STRENGTH OF AMg4 ALLOY HARDENED WITH RARE-EARTH METALS (Sc, Y, La, Pr, Nd)

Abstract. *Introduction of magnesium in aluminum in the amount of up to 6 % as the main alloying element ensures hardening of the solid solution of the alloy and high efficiency of strain hardening. This provides the alloys of the 5xxx series with rather high strength properties – higher than those of the alloys of the 3xxx series. Achieving high strength properties by hardening the solid solution with magnesium is possible since for the given purposes magnesium is particularly effective. In addition, its high solubility allows increasing its content up to 5 % in the hardest alloys. However, in alloys with a high degree of magnesium content, there is a tendency to formation of an intermetallic Mg5Al8 phase along the grain boundaries and in the areas of localized deformation within the microstructure. This is due to the fact that equilibrium solubility of magnesium in aluminum is only about 2 %. The precipitation of an excess phase in this case is equivalent to what occurs in age hardened alloys, but with a negative effect on the properties of the alloy. Particle precipitation occurs slowly at room temperature, but it accelerates under temperature elevation or if the alloy is subjected to severe cold plastic deformation. This phenomenon makes the alloy susceptible to certain types of intergranular corrosion, such as stress corrosion, and/or degradation of mechanical properties during its service at elevated temperatures.Investigation of REM effects on*

mechanical properties of the AMg4 aluminum alloy showed a rise in its strength at the REM content of 0,05-0,1 wt. %.

Keywords: *mechanical properties, hardness, strength-AMg4 alloy, rare earth metals (REM)*

O.A. Markelova, S.Ya. Pichkhidze, A.A. Fomin

TECHNOLOGY FOR CREATING INDIVIDUAL INTRAOSSEOUS CONSTRUCTIONS USING THE METHOD OF LAYERED METAL-POLYMER FILAMENT PRINTING

Abstract. *A method for creating personalized structures using a novel and promising technology of 3D-printing, which integrates a layered metal-polymer filament printing and subsequent heat treatment of the resulting structure, is proposed. Microphotographs of the metal-polymer filament and 3D-printer samples using the given material are presented. Technological modes of metal-polymer filament 3D-printing, such as layer height, maximum layer height, printing speed, nozzle temperature, and table heating temperature, have been established.*

Keywords: *additive technologies, metal-filled filament, metal-polymer, 3D-printing*