INTERNATIONAL AZERBAIJAN ACADEMIC RESEARCH CONGRESS

MAY 28-29, 2022

CONGRESS PROCEEDINGS BOOK

ISBN: 978-605-71461-7-5



EDITORS

PROF. DR. RAMILE DADAŞOVA
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TUBA FIRAT

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ONLINE & FACE-TO-FACE PARTICIPATION

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TURKEY, GERMANY
TR: +90530 139 74 89 / +90543 671 0123 GR: +4917745867777
azerbaijancongress2022@gmail.com
https://www.azerbaijancongress.com/

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BZT AKADEMİ YAYINEVİ®
BZT ACADEMY PUBLISHING HOUSE 2021©
Publishing Date: 06.06.2022
ISBN: 978-605-71461-7-5

CONGRESS ID

CONGRESS NAME

1ST INTERNATIONAL AZERBAIJAN ACADEMIC RESEARCH CONGRESS

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DÜNYADAN VE TÜRKİYE'DEN ÖRNEKLERLE YENİKLİKÇİ HEMŞİRELER TARAFINDAN GELİŞTİRİLEN İNOVATİF ÜRÜNLER 251
Tuğçe DUMAN
Özüm ERKİN

DİNİN MAKSATLARI AÇISINDAN ÇEVRE BİLİNCİ 255
Dr. Medeni ŞAVLI

INVESTIGATION OF BENDING BEHAVIOR OF E-GLASS FIBER REINFORCED COMPOSITE SANDWICHES IN INDUSTRIAL APPLICATIONS 257
Tuğçe Kızılırmak Mehmet
Turan DEMİRCİ

SİROZ TESPİTİ İÇİN TOPLULUK YÖNTEMİNİN KARŞILAŞTIRMALI ANALİZİ 263
Pınar Karadayı ATAŞ

AN OVERVIEW OF CRASSULACEAE TAXA GROWING IN BAYBURT (TURKEY) 269
Abdurrahman SEFALI

BEDEN EĞİTİMİ VE SPOR YÜKSEKOKULU ÖĞRENCİLERİNİN SPORA YÖNELİM DÜZEYLERİNİN BÖLÜM VE SINIF DEĞİŞKENLERİNE GÖRE İNCELENMESİ 275
Doç. Dr. Mustafa Can KOÇ
Doç. Dr. Erdem EROĞLU
Doç. Dr. Sultan YAVUZ EROĞLU

OPTIMIZATION OF HARDNESS AND POROSITY OF HVOF COATINGS 281
Savaş ÖZTÜRK

COVİD-19 SALGININ YAŞANDIĞI YENİ NORMAL DÖNEMDEKİ BELİRSİZLİK VE RİSK ALGISININ TÜKETİCİ SATIN ALMA DAVRANIŞLARI ÜZERİNDEKİ ETKİLERİ 283
Prof. Dr. Erkan ÖZDEMİR
İlteray SOLA

AÇIK İNOVASYON FAALİYETLERİ: RİSKLER, ENGELLER VE SONUÇLAR ÜZERİNE BANKACILIK SEKTÖRÜNDE BİR ARAŞTIRMA 297
Prof. Dr. Erkan ÖZDEMİR
Şüheyda ORAN

COVİD-19 VE ÜREME SAĞLIĞI ÜZERİNDEKİ ETKİLERİNE GENEL BİR BAKIŞ 309
Volkan EROĞLU
Özüm ERKİN

İŞ PERFORMANSINA ETKİSİ AÇISINDAN "DEVLET MEMURU" VE "DÖVLƏT QULLUQÇUSU" HAKLARI 315
Kamil Ufuk BİLGİN
Hasan SÜLEYMANLI

TRANSIENT TEMPERATURE DISTRIBUTION ESTIMATION IN SUBMERGED ARC WELDING PROCESS APPLIED TO A387 CHROMIUM-MOLYBDENUM ALLOY STEEL USING GOLDAK'S DOUBLE ELLIPSOIDAL MOVING HEAT SOURCE MODEL 325
Asc. Prof. Dr. Murat Makaraçı Mert
Turgut ŞENOL

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ABSTRACT

Welding is a process used in fabrication of similar or dissimilar structures from thin to thicker sections in several applications such as pressure vessels, chemical plants and nuclear reactors. Its nature is highly complex metallurgical process where weldments are susceptible to material discontinuities, flaws and residual stresses. Submerged arc welding (SAW) process is a widely used welding process in welding of thick plates, particularly for steel parts. SAW is essentially an automatic or semiautomatic process with consumable electrode continuously fed from a wire electrode roll. The process involves generation of heat by an arc produced between the consumable wire electrode and the work piece. In this paper, the temperature distribution in a submerged arc welding process is simulated by using finite element method (FEM). The welded base material was ASTM A387 Grade 11 Class 2 alloy steel plate for elevated temperature applications, classified by chromium and molybdenum content. Grade 11 is used in welded pressure vessels and industrial boilers, and mostly in oil gas and petrochemical industry, generally it is used for transportation of medium at high temperature. A specific FEM subroutine was utilized to apply volumetric heat flux using Goldak's double ellipsoidal heat source model. An experimental study was also conducted to measure transient temperature distributions during welding process for comparison purposes. When experimental and numerical simulation results were compared, it is proved that FEM computational approach with specified moving heat source model can estimate transient temperature distributions with a great accuracy.

Keywords: Submerged arc welding, transient temperature, FEM, Goldak's double ellipsoid moving heat source

INTRODUCTION

Arc Welding is associated with local heating of the material, which causes the melting of base material and the filler material to form a joint (Pandey et al., 2020). Submerged Arc Welding (SAW) process is a widely used welding process in the industry for welding of thick plates, particularly steel (Negi and Chattopadhyaya, 2013). Due to high deposition rate and excellent surface appearance submerged arc welding process is widely used in fabrication of pressure vessel, marine vessel, pipelines and offshore structures (Singh et al., 2015). SAW is essentially an automatic or semiautomatic process with consumable electrode being continuously fed from a wire electrode roll. The process involves generation of heat by an arc produced between the consumable wire electrode and the work piece. The arc produced is covered in a mass of fusible granular flux. The flux aids the process in many ways: it forms a protective coating over the weld, removes impurities form the weld in the form of slag, shapes the weld bead, and influences the chemical composition of the weld and its mechanical properties. Since the arc as well as the weld pool is covered by a layer or granulated flux, the loss of heat energy

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