



Friction welding of dissimilar plastic/polymer materials with metal powder reinforcement for engineering applications



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ARTICLE INFO

Article history:

Received 28 May 2016

Accepted 30 June 2016

Available online 4 July 2016

Keywords:

Friction welding

ABS

Nylon6

Shore hardness

Tensile strength

Porosity

ABSTRACT

Friction welding is one of the established processes for joining of similar as well as dissimilar polymer/plastics and metals. In past 20 years numbers of application in different areas using this process have been highlighted, but very limited contributions have been reported on properties of friction welded joints of dissimilar polymer/plastic materials after reinforcement with metal powder. In the present work an attempt has been made to perform friction welding of dissimilar plastic based materials by controlling the melt flow index (MFI) after reinforcement with metal powder. The present studies of friction welding for dissimilar plastic were performed on Lather by considering three input parameters (namely: rotational speed, feed rate, and time taken to perform welding). Investigations were made to check the influence of process parameters on mechanical and metallurgical properties (like: tensile strength, Shore D hardness and porosity at joint). The process parameters were optimized using Minitab software based on Taguchi 3³ orthogonal array and results are supported by photomicrographs.

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1. Introduction

The joining of composite materials and structures is a topic of high technological interest; since it is well known that traditional joining techniques are usually not directly exportable to composite elements (refer, e.g. to [1–4] and references therein). Attention is increasingly being given to the following research areas, both experimentally and numerically: fusion bonding [5,6]; welding-based joining techniques [7–14]; friction spot and friction lap joining [15,16]; and ultrasonic joining [17]. Friction welding is a process of joining of materials and structures below their melting points. When these materials come in contact with relative motion to each other, with the action of friction, heat is produced and deformation takes place, due to this intermolecular diffusion is occurred between their faces and thus welding is performed. Friction welding concept was originally come for similar metal joining, but it was further applied for similar thermoplastic composites [18]. Later on this concept was used for the dissimilar materials like steel-aluminum and steel-copper and aluminum-magnesium cylindrical piece joining [19,20] and for dissimilar plastic welding of ABS to

HDPE [21]. The number of studies has been reported to check the mechanical, thermal and metallurgical properties of friction welded piece [22–24]. Interface properties are examined to check the fusion, deformation mechanisms and microstructure characteristics of friction welded interface [20,25–26]. ABS and Nylon6 are commonly used thermoplastics with excellent mechanical properties and are used generally for friction welding application [21]. The joining of ABS or Nylon 6 to itself or welding of ABS to HDPE is feasible [27] but, there is a limitation of joint strength (for friction welded joints) of these thermoplastics that hinders its use in different engineering applications.

Some studies have highlighted the use of a tool in the form of a ring which is rotated in between the interface of two pipes. This is getting heated deformed by friction created due to rotation of ring, so welding of pipeline is possible [28]. Friction inertia welding concept is widely accepted in aerospace applications [29,30]. Reinforcement of polymer with nano-composite is the technique to make the feasibility of friction welding process. The studies also highlight that friction spot welding of polymethyl-methacrylate and polymethyl-methacrylate-SiO₂ is feasible [31]. The reinforcement of nano-composite with polymers is responsible for the improved mechanical and metallurgical properties [32–36].

The literature review reveals that joint strength properties of friction welded joints of ABS with Nylon6 are not good enough

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Friction Welding Of Dissimilar Plastic Polymer Materials

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Table of Contents Friction Welding Of Dissimilar Plastic Polymer Materials

1. Understanding the eBook Friction Welding Of Dissimilar Plastic Polymer Materials
 - The Rise of Digital Reading Friction Welding Of Dissimilar Plastic Polymer Materials
 - Advantages of eBooks Over Traditional Books
2. Identifying Friction Welding Of Dissimilar Plastic Polymer Materials
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Friction Welding Of Dissimilar Plastic Polymer Materials
 - User-Friendly Interface
4. Exploring eBook Recommendations from Friction Welding Of Dissimilar Plastic Polymer Materials
 - Personalized Recommendations
 - Friction Welding Of Dissimilar Plastic Polymer Materials User Reviews and Ratings
 - Friction Welding Of Dissimilar Plastic Polymer Materials and Bestseller Lists
5. Accessing Friction Welding Of Dissimilar Plastic Polymer Materials Free and Paid eBooks
 - Friction Welding Of Dissimilar Plastic Polymer Materials Public Domain eBooks
 - Friction Welding Of Dissimilar Plastic Polymer Materials eBook Subscription Services
 - Friction Welding Of Dissimilar Plastic Polymer Materials Budget-Friendly Options
6. Navigating Friction Welding Of Dissimilar Plastic Polymer Materials eBook Formats

- ePub, PDF, MOBI, and More
 - Friction Welding Of Dissimilar Plastic Polymer Materials Compatibility with Devices
 - Friction Welding Of Dissimilar Plastic Polymer Materials Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Friction Welding Of Dissimilar Plastic Polymer Materials
 - Highlighting and Note-Taking Friction Welding Of Dissimilar Plastic Polymer Materials
 - Interactive Elements Friction Welding Of Dissimilar Plastic Polymer Materials
 8. Staying Engaged with Friction Welding Of Dissimilar Plastic Polymer Materials
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Friction Welding Of Dissimilar Plastic Polymer Materials
 9. Balancing eBooks and Physical Books Friction Welding Of Dissimilar Plastic Polymer Materials
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Friction Welding Of Dissimilar Plastic Polymer Materials
 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
 11. Cultivating a Reading Routine Friction Welding Of Dissimilar Plastic Polymer Materials
 - Setting Reading Goals Friction Welding Of Dissimilar Plastic Polymer Materials
 - Carving Out Dedicated Reading Time
 12. Sourcing Reliable Information of Friction Welding Of Dissimilar Plastic Polymer Materials
 - Fact-Checking eBook Content of Friction Welding Of Dissimilar Plastic Polymer Materials
 - Distinguishing Credible Sources
 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
 14. Embracing eBook Trends
 - Integration of Multimedia Elements
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