Chapter 4
Surface Engineering by Friction Stir Processing and Friction Surfacing

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ABSTRACT
This chapter is focused on the recent advances in the solid state surface engineering techniques including Friction Stir Processing (FSP) and Friction Surfacing (FS). The effectiveness of FSP and FS in improving the surface properties is explained in detail along with the principles, applications, advantages, and disadvantages of these techniques. The parameters affecting FSP and FS are presented. Various surface properties improved in different alloys by FSP and FS along with the results of the recent research work is presented in this chapter. The shortcomings of the processes and ways to overcome them are discussed. The effect of FSP on pitting corrosion of AA 6082 is studied and the results are presented.

INTRODUCTION: THE IMPORTANCE OF SURFACE ENGINEERING

In day today life, whenever we are purchasing any article, the first thing we notice in our selected object is the surface appearance. Even if there is a small scratch on its surface, we reject the article and ask for a new article of the same brand and
colour. The price of any article is dropped down if there are any damages externally. Hence, the surface appearance is very important immaterial of whether it affects the functionality or not. However, in engineering component, though aesthetic appeal is given importance, functional performance is primary. The surface is the part which experiences the most material degradation in engineering applications. Hence in most of the applications, surface modification is required to delay the material degradation and to enhance the functional performance of the component. The factors responsible for material degradation can be physical, mechanical, biological or a combination of these. Applying any protective measure to an engineering component involves the following four steps:

1. Cleaning the surface or surface preparation
2. Selection of suitable surface modification technique by analysing the reason for material degradation,
3. Process control to obtain the desired properties and
4. Maintenance of the modified surface.

Surface engineering embraces those processes which modify the surfaces of engineering components to improve their in-service performance, useful working lifetimes, aesthetic appearance or economics of production.

The purpose of surface modification may be to minimize corrosion, reduce frictional energy losses, reduce wear, to provide thermal insulation, to exclude certain wavelengths of radiation, to promote electronic interactions, electrically insulate or simply improve the aesthetic appearance of the surface.

Any surface engineering technique involves two steps viz:

1. Surface Preparation, and
2. Surface Treatment.

**SURFACE PREPARATION**

This is the first and primary step in any surface engineering technique. Any unwanted impurity and residue on the surface should be properly cleaned before any surface treatment process. This enhances the quality and life of the following surface treatment. Improper surface preparation leads to the failure of the surface treatment. There are many surface preparation techniques and the suitable process should be chosen depending on the nature of the substrate and subsequent surface treatments. Grease removal, alkaline bath cleaning, electrolytic bath cleaning, manual cleaning, mechanical cleaning, flame cleaning, blasting, shot peening, acid treatment, molten
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