

Failure Analysis of Tuna Cans

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Abstract A metal container used for food packaging must preserve the food's edibility characteristics for a long period of time. Lacquered tinplate is suitable for canning food provided that the cans are airtight. This article details a root cause failure analysis that was conducted utilizing a sample of tuna cans taken from an affected batch of one million units. Several examinations were carried out to identify the failure's root cause: visual examination, SEM fractography, micro-hardness measurement, and microstructural characterization. The cracks are located in the HAZ of the welded zone. As a result of the examinations carried out, the authors were able to identify the cause of the primary failure. The identified fracture mechanism is that of stress corrosion cracking (SCC), due to both the aggressive environment (high water content in the oil) and the low lacquer adhesion caused by superficial welding irregularities.

Keywords Can · Stress corrosion cracking · Lacquer · Welding

Introduction

Tinplate is the most commonly utilized material for the manufacture of metal food cans. Despite the increased use by the canning industry of the new alternative materials (e.g., aluminum, chromate steel sheet, etc) tinplate

continues to be the industry standard. Tinplate is continually being developed with a view to achieve the progressive reduction in its weight for economic and environmental reasons (waste reduction) [1].

The basic material used in tinplate production is low carbon steel. In order to achieve high mechanical strength, the steel strip is given a stronger reduction on a double reduction mill. For packaging purposes, the steel strip receives an additional protective coating, and this is when it becomes known as tinplate [2]. The steel sheet is passed through an electrolytic strip coating line, and a thin layer of tin is applied to its surface. Polymer coatings must be applied to the sheet steel for specific applications. Coated tinplate can be directly converted into cans, offering outstanding protection properties. Numerous organic coatings are available to can manufacturers, which are chosen on the basis of product resistance and fabricability [3].

A large share of processed food (i.e., meat and fish products) reaches the consumer annually in the form of high-quality canned goods. However, metal containers occasionally develop integrity issues, which can lead to early failure through corrosion, loss of seal integrity, and discoloration, all resulting in canned goods being rejected by the consumer [4]. Many different can integrity issues have been reported and include corrosion phenomena such as stress corrosion cracking (SCC) [4–6]. Tinplate corrosion depends on many factors, including the can material (tin-coated steel, tin-free steel), the nature of the organic coating (epoxy, polyester, and acrylic resins), enamel properties (adhesion, porosity, and corrosion resistance), the nature of the contacting medium (aqueous, fatty foodstuffs, etc.) and, of course, composition of the contained product (acidic food, sulfur, and/or salt-containing food, etc.) [3, 7].

The aim of this article is to identify the main failure cause of a large batch of canned tuna in olive oil (1 million

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