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Failure investigation of a centrifuge duplex stainless steel basket

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ABSTRACT

Starch is an essential ingredient for both food and non-food industrial sectors. One of the steps on the manufacturing process of starch is centrifugation by means of huge rotating baskets. In the present case, a basket of more than 2 m in diameter was made of duplex stainless steel. The minimum service life of this type of baskets is established in 15 years. However, after around 5 years in service, the automatic security system of the centrifugal process stopped the basket rotation. The component was then examined by dye penetrant and a through-wall crack with more than 50 cm of surface length. In order to determine the reason (or reasons) for such failure, an investigation was performed. This investigation included material analysis, mechanical testing, and fractographic studies. A high level of shrinkage porosity was detected and considered as the main responsible of crack nucleation. Also, the presence of nitrides contributed to a fast propagation of the crack front.

1. Introduction

1.1. Starch production

Starch is a polymer generated by plants and composed of glucose that has became one of the most omnipresent biomaterials due to its unique biodegradability and solubility characteristics. Being a pure renewable natural polymer, starch has a multitude of applications. It is indispensable for the food industry (75% of the calories consumed by humans worldwide are provided by starch, which is present in the manufacture of sweeteners, as food thickener, stabilizer, etc.), but it is also used for paper and cardboard production, textiles, cosmetics, pharmaceuticals, construction and paints [1]. More than 60 million of tons were consumed in 2004 [2] and, in a next future, starch will play an increasing role in the field of "renewable raw materials" for the production of biodegradable plastics, packaging material and moulds [3].

Starch production comprises three main steps: milling, centrifugation, and purification. The most important starch sources are corn, wheat, potatoes, tapioca, and rice. These raw materials are milled to extract proteins giving rise to a slurry. In order to transform the slurry into a usable form, the liquid must be removed up to achieve a moisture level of around 15%. The usual process for removing moisture is by centrifugation in machines especially suited for dewatering of granular solids. The investigation of the failure of one of those centrifuge machines is reported in the present article.

1.2. The machine

A centrifuge is a mechanical device using the centrifugal force to separate substances of different densities. The failed centrifuge is one of the largest sizes nowadays in service, with 20 tons of empty weight and a production capacity up to

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