17 Home Farm Avenue, Macclesfield, SK10 3QW
T: +44 (0)1625 501054 M: +44 (0)7908 257196

ROSE CONSULTING ENGINEERS LTD

Flow Distribution Inside a Reformer Burner.

1. Introduction

Ammonia production involves steam reforming of natural gas to generate a reaction mixture of Hydrogen and Nitrogen. Reformer burners are used at the first and second stages of ammonia production. In the second stage, a partially reformed mixture of natural gas and steam is combusted in air at 40Barg and 450^{0}C. The amount of air added determines the amount of Nitrogen available for Ammonia synthesis in the catalyst bed down stream of the burner.

Our client's business is the manufacture of catalysts used in this process along with the design and development of the associated burners. In a recent re-design, the plant capacity was up-rated by increasing the operating flows to 55% above the original design level. As a consequence, many of the burners began to fail prematurely.

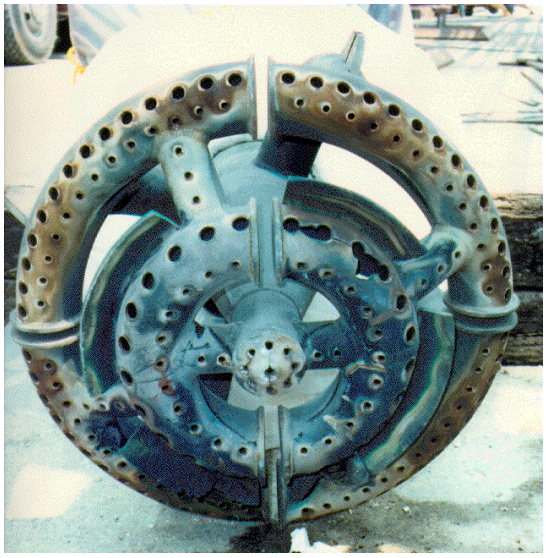

Figure 1: Secondary Reformer Burner after a few weeks operation at the up-rated flow. Significant damage is present on the inner ring

2. The Model

Due to the complex geometry of the burner, an unstructured meshing strategy was used. This study examined the internal flow distribution within the burner ring and interconnections.

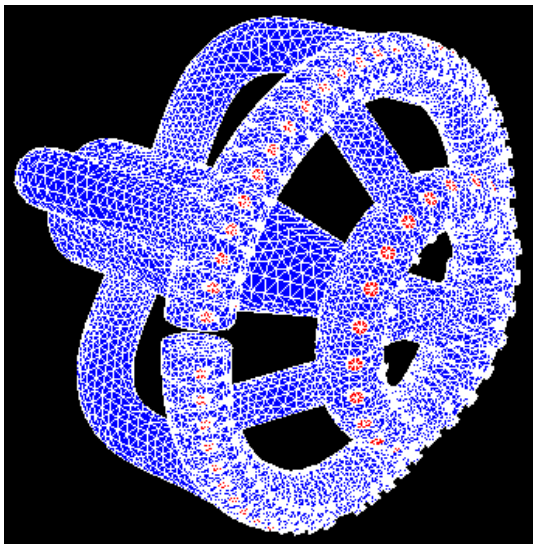

Figure 2: Unstructured surface mesh

3. Results

The internal flow was seen to consist of many re-circulating regions. These re-circulations resulted in poor internal cooling and subsequent damage from high thermal stresses.

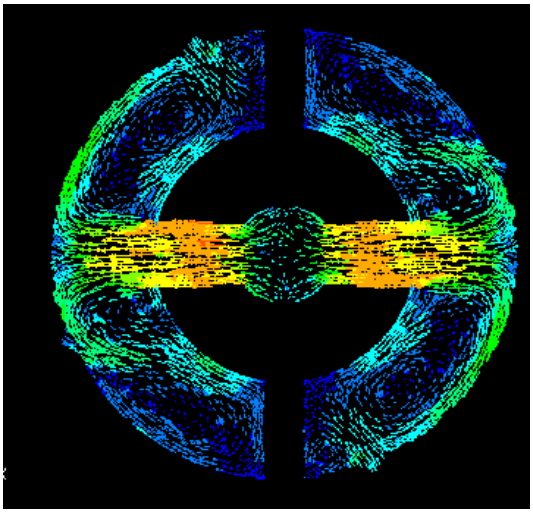

Figure 3: CFD results revealing a large recircultion in the damaged area.

4. Recommendations

A new arrangement of interconnections was proposed to give a balanced internal flow. This recommendation, along with others from a CFD combustion study, resulted in a significantly prolonged burner life.

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