



CORROSION IN REFINERY INDUSTRY FAILURE ATLAS

CASE HISTORY n° 1 Date

Process: Hydrocracking
Equipment: First stage reactor

DATE OF INCIDENT AND/OR INFORMATION: December 2001

NATURE OF THE INCIDENT : formation of sulphide scale on the internal weld overlay and internal equipment of the reactor, separating the outer layer of the scale and settling the scale deposits onto the bottom catalyst bed, plugging the outlet and local overheating the bottom of the reactor

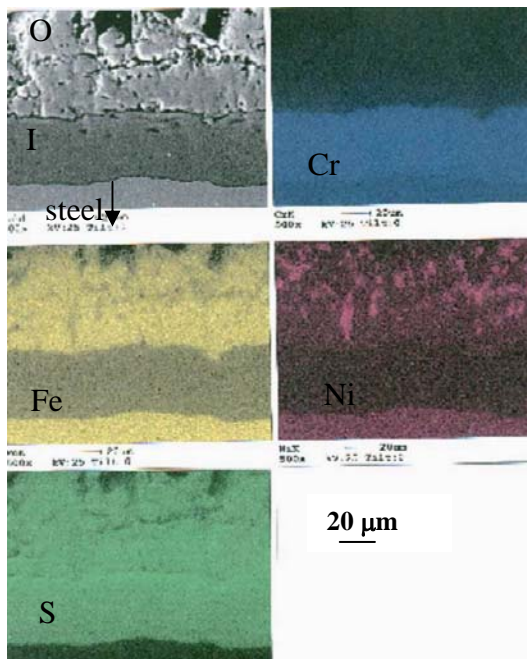
CONSEQUENCES : unplanned shut-down, heavy scale deposits inside the reactor, degradation of reactor materials

MATERIAL COMPOSITION and REFERENCES:
austenitic steel 18Cr-10Ni0Nb, type 347: internal equipment and weld overlay over base material
2.25Cr-1Mo-0.25V steel

PICTURES AND SCHEMES :



Internals of the reactor covered with sulphide scale



Cross-section of sulphide scale: microstructure and SEM/EDS maps of Cr, Fe, Ni, S
O – outer layer of the scale
I – inner layer of the scale

ASPECT :

MEDIA AND OPERATING CONDITIONS: liquid hydrocarbons and hydrogen gas, 370°C, content of S in hydrocarbons = 1.6-1.9 wt.%, $ppH_2 = 15$ MPa, content of H_2S in hydrogen gas = 12 ppm at the reactor inlet, 1.2 vol. % at the reactor outlet

TIME TO DETERIORATION : 23 months



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ANSWER

TYPE OF CORROSION: High Temperature H₂/H₂S Corrosion
API 571 CLASSIFICATION: 5.1.1.5

CAUSES : temporary excessive content of sulphur in the feed

REMEDY : control of sulphur content in the feed

PUBLICATION - TECHNICAL REPORT:

1. J. Hucińska, Sulphide corrosion behaviour and microstructural changes of 347 stainless steel in hydrocracking reactor environments. 15th International Corrosion Congress "Frontiers in Corrosion Science and Technology", Granada, Spain 22-27 September 2002

BIBLIOGRAPHIC REFERENCES :

1. G. Sorrel, W.B. Hoyt, NACE Technical Committee Report, Publication 56-7, Corrosion, 12, 213t (1957)
2. NACE Technical Committee Report, Publication 57-3, Corrosion, 13, 37t (1957)
3. J.D. McCoy, F.B. Hammel, Materials Protection and Performance, 10, 17 (1971)
4. A.S. Couper, J.W. Gorman, Materials Protection and Performance, 10, 31 (1971)
5. J. Gutzeit, in: Process Industries Corrosion – The Theory and Practice, NACE (1986)