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Non-Destructive Control of a Hydraulic Hammer Piston, Designed for Geological Exploration Activities

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Abstract

The piston part provided to us by the Bulgarian company to clarify the reason for its breakage.

Keywords: Steels; Non-destructive testing; Macrostructure

Standards used in Peer Review

a) BS EN 13018:2016 Non-destructive testing. Visual testing. General principles Released: 2016-02-29

b) BS EN 13927:2003 Non-destructive testing. Visual testing. Equipment, 2003

c) BS ISO 5579:2013 Non-destructive testing - Radiographic testing of metallic materials using film and X- or gamma rays - Basic rules

d) ISO 3452-1:2013 Non-destructive testing - Penetrant testing - Part 1: General principles

e) ISO 3452-2:2013(en) Non-destructive testing - Penetrant testing - Part 2: Testing of penetrant materials

f) BS EN 10228-2:2016 Non-destructive testing of steel forgings. Penetrant testing

g) ISO 23277:2015 Non-destructive testing of welds - Penetrant testing- Acceptance levels

h) ISO 10675-1:2016 Non-destructive testing of welds - Acceptance levels for radiographic testing - Part 1: Steel, nickel, titanium and their alloys

i) EN ISO 17637:2016 Non-destructive testing of welds - Visual testing of fusion-welded joints

j) EN 1371-2:2015 Liquid penetrant testing - Part 2: Investment castings.

Test Method

Visual inspection according to standards [1,2]. No defects in the base metal, as well as surface staining are observed.

Material - after the spectral analysis it was found that the sample is made of steel type 40Ch2N2MA. Analog to DIN 1.6565 40NiCrMo 6. Analog: Japanese brand JAPAN JIS No. G 4103 steel grade SNCM8 of type.

The rolled product made of the above-mentioned material with ϕ160mm and in the range of 100 ÷ 400 mm is with subsequent heat treatment of the forging-hardening 850°C in oil and annealing at 610°C, which allows a part made with additional machining to be loaded to energy impact 5120 J according to the provided documentation (Figures 1 & 2).

After the performed radiographic control according to the current standards BDS EN ISO [3] and [4], Figures 3 & 4 show the found inadmissible pores and voids A> 10%.

Conclusion

The FUROKAWA FXJ 275 hydraulic hammer part was broken due to the large number of cracks inside the forging, as well as pores and cracks at two diametrically opposite ends, leading to the formation and development of a highway crack [5-9] (Figure 5).

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Figure 1: Broken piston- furokawa.

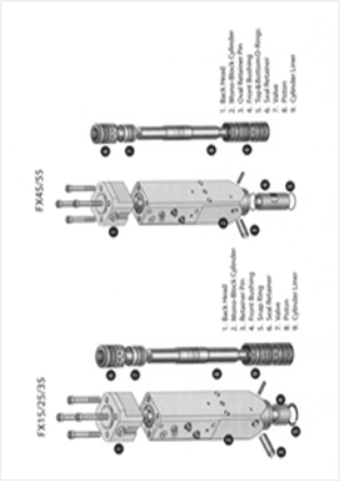

Figure 2: Drawing of the piston by documentation, item 8.

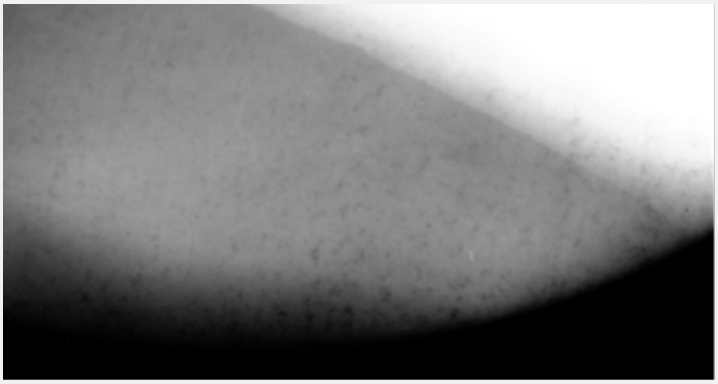

Figure 3: Inadmissible pores.

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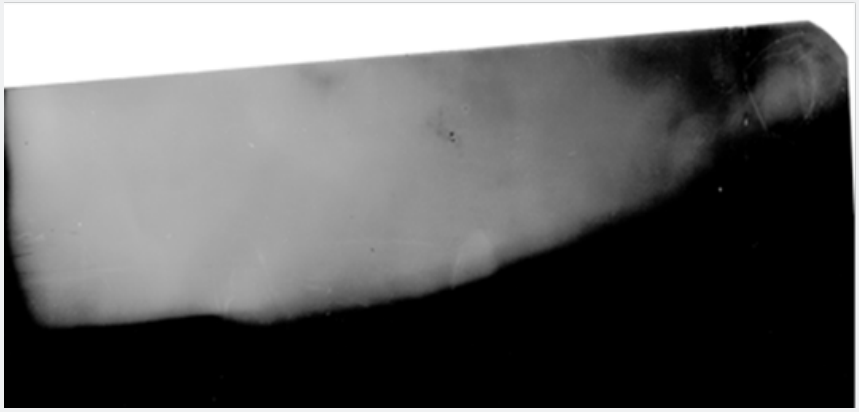

Figure 4: Voids A> 10%.

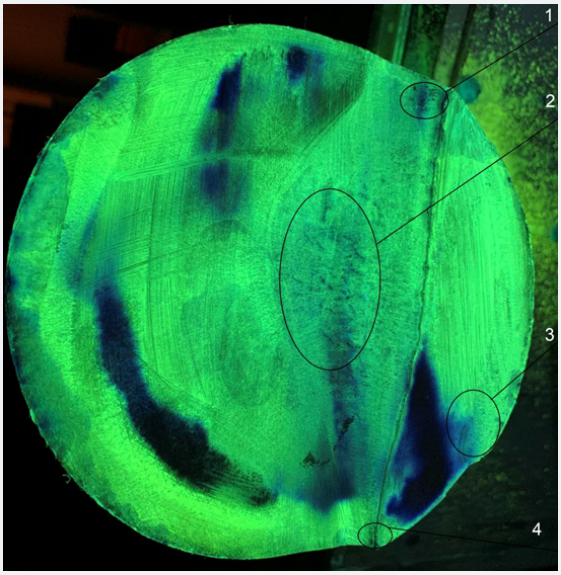

Figure 5: Analysis with penetrating liquids. A) Cluster of pores in the area of the fracture and an initial crack with a length of about 35 mm. B) Cracks min 15 pieces with lengths between 1.5 and 12 mm. C) Single pores with dimensions between 0.5 and 2 mm. D) Pores and a crack measuring about 9 mm.

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