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Dangerous Occurrence - Crane hoist rope failure

1. The incident

- 1.1. The load being lifted was within the Safe Working Load (SWL) of the lifting equipment.
- 1.2. The rope break was 3 metres from the dead end (1.7 metres from the bottom of the rope drum). The break was spread over approximately 0.5 metres.
- 1.3. Tests carried out by the user company confirmed that the crane's ultimate limit and overload limit switches were functioning correctly at the time of the incident.
- 1.4 The rope was a high tensile steel rope of left hand "Langs Lay" construction with a 71, 500 kN breaking strength manufactured in 2003 and installed in February 2004.
- 1.5. In this particular case the hoist has a thorough examination every 6 months, and the defect/issue with rope life had not been highlighted by the competent person doing these examinations.
- 1.6. The user company sent the failed rope to a laboratory for metallurgical examination. The conclusion was that fatigue was the most likely cause of failure, and that this can be attributed to an excessive number of reverse bending duty cycles together with the tight-radius generated by the radius of the rope pulleys.

2. Relevant Standards and Guidance

2.1. BS ISO 4309: 2004 – Cranes – Wire Ropes – Care, maintenance, installation, examination and discard. Clause 3.4.2.1 (c) covers the points to be covered by the examination of ropes and states that, in the case of cranes performing a repetitive examination, these should include any part of the rope that lies over sheaves(s) while the crane is in a loaded condition.

3. Previous history of incidents in the paper industry

3.1. There has been a history of rope failures on paper machine dry end cranes where repeated raising, short distance horizontal transfer and lowering operations have taken place previous safety alerts have been issued.

3.2. Paragraph 9 of PABIAC Bulletin 8: Management of Lifting Equipment – 'Wire rope hoists and hood doors' said:

3.2.1. 'Have I checked for and considered other factors that can reduce fatigue life? Fatigue life is a function of repeated load cycles – increased usage will "eat up" the fatigue life of the equipment more quickly than the original specification if usage has increased. If you use the equipment to lift more loads, despite remaining within the SWL, you will reduce fatigue life.'

3.3.1. Also think about:

'Side loading of hoist units that create shock loadings on the wire rope resulting in rapid wear and damage: too small or worn wire rope grooves in the pulley wheels or rope drum; sticking sheaves':

4. Action

4.1. Fortunately nobody was injured in this incident. However the potential for it to have led to serious or even fatal injury is self-evident.

4.2. Employers in the paper making and converting industries should critically examine their own arrangements for maintenance, care, examination and replacement of wire ropes on lifting equipment in the light of this incident. Particular attention should be paid to the arrangements for maintenance, examination and frequency of replacement of hoist ropes on lifting equipment used for repetitive operations.

4.3. Employers should also consider the configuration of rope pulleys including the size of rope grooves and the arrangements for maintenance and examination of the pulleys and their grooves. Unsuitable pulley configurations, pulley grooves that are too small or worn and sheaves that stick will accelerate fatigue, wear and other damage to the wire rope.

4.4. When undertaking 4.3 it is important to know the ratio between the rope diameter and the pulley diameter - as this is critical when establishing the number of reverse cycles as well as the rope diameter and its compatibility with the grooves. It is very unlikely that employers and engineering staff on site will have the 'competence' to do this and will therefore need to consult with hoist manufacturers and rope suppliers to make sure they have it right.

4.5. In light of this incident, employers using lifting equipment on this sort of duty should also speak to the Competent Person who carries out the statutory through examinations of the crane and lifting rope to confirm that the periodicity of thorough examinations and the arrangements for thorough examinations are suitable.

4.6 On a general note: The scope of Thorough Examination is limited to matters found by the Competent Person during his inspection. Where an inspection of the lifting rope takes place (British Standard 4309 provides guidance on rope discard criteria and indicates a 20% visual check) this may not highlight problems if there are no obvious defects or indicators present. It is therefore essential that the user implements a suitable preventive maintenance regime based on the application and service history of the specific machine, in conjunction with the Manufacturer's recommendations. Statutory examinations under LOLER should never be treated as a substitute for maintenance (or having a properly designed lifting machine).