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ENGINEERING FAILURE ANALYSIS OF SEVERAL DIFFERENT MECHANICAL SYSTEMS: A REVIEW ANDDISCUSSION

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Abstract- Mechanical system design and development must be tested and verified for performance, and it is crucial to understand why systems fail. Depending on the nature, kind, and application of the system, several analyses are conducted to determine the precise reason of damage or failure. This paper intends to give numerous case studies in the area of mechanical system engineering failure analysis.

Key Words: Failure Analysis, Gear, Fatigue etc…

1. Introduction

Mechanical system design and development must be tested and verified for performance, and it is crucial to understand why systems fail. Depending on the nature, kind, and application of the system, several analyses are conducted to determine the precise reason of damage or failure. This paper intends to give numerous case studies in the area of mechanical system engineering failure analysis.

1.1 Literature Review:

The failure of Co-Cr casting hip resurfacing prostheses has been researched by the author. When this prosthetic device is operating, cracks cause a catastrophic fatigue breakdown. The research demonstrates that hot ripping in the hip resurfacing stem during production results in fracture. The carbon steel elbow portion of piping utilized for an oil-gas separator vessel was examination by the author. Chlorination and sulfidation processes are to blame for the corrosion.

The hydrogen sulfide and calcium chloride contained in crude oil are linked to the chlorination and sulfidation processes. R.K. Upadhyay and others The Rolling Contact Fatigue (RCF) that develops as a result of cyclic stress during operation is the main topic of this research. False

Brinelling due to vibration or sliding oscillation tends to destroy the bearing surface quickly. It is recommended that bearing life be extended. George A. Pantazopoulos and others. The examination of a machinable brass connection failure in a boiler unit installation is the main topic of this research. Visual inspection, light and scanning electron microscopy together with local elemental energy dispersive X-ray spectroscopy are used to carry out the analytical analysis. According to the research, failure is caused by gradual cracking that leads to fatigue failure. Adjustments to the alloy and to the technique for ensuring the quality of tube assembly during installation are the two key adjustments advocated.

The failure of bevel gears in an aviation engine was looked into by the author. Due to minute structural differences in the gear material, contact fatigue was the mechanism of failure. The simultaneous rolling and sliding motion of the meshing teeth caused extreme wear and removal of the hardened case at the driving gear teeth. The author used a metallurgical check to research the Central Burst Problem. Three damaged wires that failed during manufacture were examined in this investigation. According to the study, the first two wires break as a result of the development of a hard and brittle phase, while the third wire fails as a result of improper drawing procedures. The premature breakdown of heat trace tubes used in blast furnaces to transport waste hot gases has been researched by the author. Corrosion, which is a result of moisture and sulfuric acid reacting with the tube material, is what led to the collapse.

Low alloy steel welded pipes that were buried have been looked at by the author. Pipe failure was due to low ductility fracture in the weld, which also had many intergranular secondary fractures, not tensile ductile loading, which would have been the more likely reason. Around the pipe, several surface folds or fractures were seen. For the investigation, analytical methods such chemical analysis, visual examination, and optical microscopy were used.

The author has looked into the thermo-mechanical process parameter optimization and failure analysis of titanium alloy (Ti-6Al-4V) fasteners for aerospace applications. The fasteners made

of the titanium alloy (Ti-6Al-4V) are prone to fatigue failure due to the socket head hole penetrating the shank. Experimentation is carried out to optimize the strain rate. The results of metallurgical testing under ideal processing conditions do not support microstructural heterogeneity. The author has looked at the reasons of cracking in ISOMAX units, including the reactor, valves, tubings, etc. A thorough analysis reveals that the failure was brought on by stress corrosion cracking (SCC), which is brought on by the presence of chloride in the applied anti-seize grease. The study is ascribed by four criteria that may cause failure. Among them, Armando Ortiz The author has researched spark plug failure brought on by the interaction of an intense magnetic field and harmful gasoline additives.

A short circuit caused by the magnetic field results in ineffective combustion and soot buildup on the insulator surface. However, organ metallic anti-knocking compounds found in inferior fuels cause failure. The government's move to impose compliance with gasoline composition rules is the only effective solution to the issue.

A 110 MW thermal power plant's low pressure (LP) steam turbine blade fracture was investigated by the author. These blades were crafted from stainless steel martensitic alloy X20Cr13, a chrome alloy. Visual inspection, SEM fractography, chemical analysis, hardness testing, and microstructural characterisation make up the research. Corrosion-fatigue is the root of the problem. The author has researched thermowell fatigue failure in a natural gas production plant's downstream feed gas supply pipeline.

The wake frequency of the employed straight type thermowell grew beyond its normal frequency as a result of the pipeline medium's high flow velocity. This causes a resonance that absorbs a lot of energy and generates a lot of tension. Installing new modified truncated conical-type thermowells fixed the issue.

The author has explored superalloys based on nickel that are used to make gas turbine blades. The failure happened as a consequence of high temperature exposure that caused oxide grooves on the blades' fracture surface.

An alumina manufacturing plant's flash evaporator failure study was researched by the author. Caustic embrittlement is the root cause of the flash evaporator's failure. In this investigation, the following techniques were used: macroscopic observations, metallurgical observations,

microscopic observations, and EDS analysis. A.H.V.The author has investigated the pinions used

in the bowl mills of fossil fuel-fired power plants to transfer torque from the engine to the gear box. Fractography reveals that the corner of the keyway is where the fracture first started. Mechanical testing demonstrates that the material's yield strength was less than the desired value. This research concludes that this failure has consequences.

The author has looked at tapered roller bearings that fail too soon. The is completed with the use of visual inspection, chemical analysis, microhardness, microstructure, retained austenite measurement, wear debris analysis, and scanning electron microscopy (SEM). Uneven load distribution of the rollers and the raceway caused by misalignment was cited as the reason for early failure. The failure of an elevator chain wheel shaft has been researched by the author. The research is conducted to determine the reason of the subsequent break even if the warranty period has already passed. It also serves to check that the shaft material complies with technical documentation.

Due to dynamic, alternating, and relatively modest tensile-compressive stresses, the shaft broke. It has been proposed that hardening the shaft's surface might prevent shaft breaks. The author looked at the metallurgical study of SA-106 Gr. B pipe failure while hot bending. These grade pipes are used for feed-water reducers in Pressurized Water Reactors (PWR), transporting liquid ammonia from an ammonia heater to a urea reactor, drain lines in power reactor components, etc.

The research demonstrates that greater inclusion content combined with overstress contributed to fracture development. During the induction heating process, a rapid thermal expansion led to the excessive tension.

For durability and fault analysis, the author looked on prestressed reinforced concrete collapse in maritime applications. Since corrosion is the cause of the prestressed R.C.'s failure, a service life study is conducted. Lack of enough protection for the strands' outside portion. Strut and tie model is utilized to provide reliable failure analysis.

The failure of cold pulled wire caused by hydrogen embrittlement has been researched by the author. To determine the main reason for this specific failure, fractography analysis is employed. Heavy loss is caused by wire breaks during drawing operations. The experimental investigation supports the theory that hydrogen embrittlement is to blame for failure.

The author has researched conveyor pulley shaft failure. Because the shaft was improperly reconditioned, it fails. Fatigue is the cause of shaft failure. The author has researched rubber hose

failure in applications with anhydrous ammonia. The Fractography reveals that the hose rupture spreads from the interior to the exterior. The rubber hose pipe bursts because the first and second reinforcing layers' mechanical qualities were lost, lowering the hose's maximum permissible pressure below the working pressure encountered during an ammonia transfer.

The author has investigated the development of fatigue cracks in a continuous caster roll's bimetal. According to the research, the increased plastic deformation in this region causes increased dislocation density and quick plasticity fatigue (at the macro level), on the one hand, and accelerates crack propagation at the macro level, on the other.

CONCLUSIONS

As was previously said, many forms of analysis must be carried out in order to determine why a system fails. All of the writers, who come from various backgrounds, selected and assessed specific examples for the research. They have used both analytical and experimental methods to investigate the mechanical systems' failure and come to the same conclusion.

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