

Failure Analysis And Preventive Maintenance of Hydraulic Rubber Hose

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Abstract- A hydraulic hose is important component of hydraulic machines. these machines are used in mining, industrial works and construction fields .in these paper we are identify the failure cause of hydraulic hose of earth moving machines. we have conduct survey of the failure hoses and workings of hose and collect the experts advise of the hose companies and workshop of hose installations and in this works we have prepare FTA of hose system and analysis the cause of failure and develop a preventive measure for high pressure hose.

Keywords- hydraulic hose , hose failure ,preventive maintenance ,FTA etc.

I. INTRODUCTION

A hydraulic hose is specifically designed to convey hydraulic fluid to or among hydraulic components valves, actuators and tools .it is typically flexible, often reinforced by several layers since hydraulic system frequently operate at high or very high pressures. it is important part of hydraulic machines .it is crucial point to clarify the cause of defects and reduce the equipment failure or risk of personal injury.

The hydraulic hose and its fittings are important to transfer energy from one part to another part of hydraulic machines as earth moving wheel loader ,hydraulic excavator ,crawler dozer etc. these machine are works in very difficult environment and heavy loading ,lifting . Hose pipe operate on very high pressure due to this various types defect are occurs . environmental exposure and changing in working pressure effect the hose pipe ,some time different hydraulic oil also corrosions internal materials .defects mainly occurs hose installation and different type bending angles or wrong hose material selections

In this work we are selected some specific hose which are used in earth moving hydraulic machine and failure occurs in hose during machines works.



Figure no.1. Example of pressure hoses damaged .[4]

These hydraulic machine works in various situation due to this hose failure occurs via different reasons so we want to find cause of failure of hydraulic hoses. Fault tree analysis is a systematic safety analysis tool that proceeds deductively from the occurrence of an undesired event (accident) to the identification of the root causes of that event [4].Fault tree analysis starts with a ‘‘top event’’ that generally display with rectangular and related events based on logical relations with the top event that are drawn below, branching downward as in a tree [10]. In most cases, the top event is chosen based on its criticality. In addition, intermediate events based on the reasons for their occurrence are divided into the following branches. The analysis continues at each level, until basic causes or the analysis boundary conditions are reached

II. LITERATURE REVIEW

Hydraulic rubber hose defects analysis studies by experts from academic and practice. **Taylor** et al.(1)suggests fatigue and burst tests to investigate the failure modes of high-pressure hoses at their rated working and burst pressures. **Miller**[2] develop a systematic techniques to analyse industrial and automotive hose failures and discussed on end use requirements for textile reinforcement cords versus hose specifications and use operating environments. **Evans** et al.[3] performed an analysis to understand further the characteristics of the flexible hose, which was pressurized numerous. **Marquez** et al.[4] researched defects in a flexible metal hose at compressor The fractures in the wires were consequences of fatigue crack propagation in previously worn areas .many researchers developed and studies to perform NDT and its benefits. **Budinski** [4] provide the structure analysis of the

ruptured hose, comprised of nit rile rubber, layers of chloroprene rubber and yarn braids, by the micro FTIR spectra method, optical microscopy and optical fractography. **Withers and Preuss** [5] reviewed progress using X-ray computed tomography to study damage accumulation. Their study includes both measurements of damage accumulation and the incremental monitoring of damage-accumulation processes during life (sometimes termed four-dimensional tomography). A failure analysis of the fuel hose used in an aircraft auxiliary fuel system [6]was conducted using a Keyence VHX-100 K digital microscope to characterize the macro features of the failed sample. The fracture surfaces were examined using a Hitachi S-3500 N scanning electron micros. and **Bernard et al.**[7] suggests a solution in order to improve the efficiency of the geometric and dimensional control process The solution is an application and adaptation of the visibility theory to the automatic determination of the scanning strategies to converts 3D parts in digital .**Chiffre et al**[8] performed industrial applications of computed tomography. Their paper contains a survey of the state of the art and upcoming CT technologies as well as a survey of application examples from the manufacturing industry and from other industries. after reviews above papers we have find there is lack of systematic approach to find cause of hydraulic hose system failure .now we have develop a fault tree of hose system to identify the failure factors and develop preventive strategies.

III. METHODOLOGY

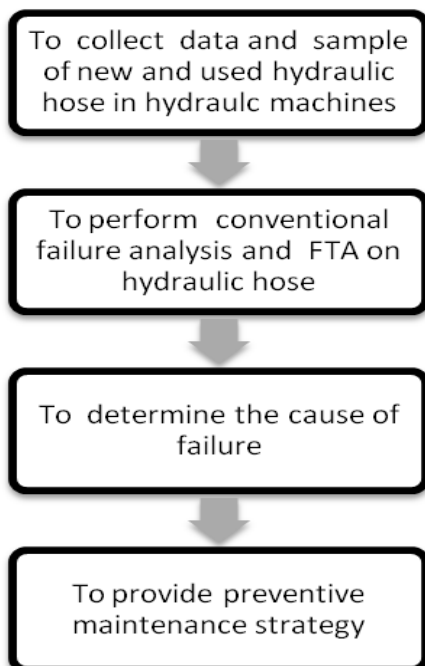


Figure no 2. Process of failure analysis of hydraulic hoses

Fault tree analysis: it is a important technique to find the root cause of failed system .now we have collected data from various hose industries and workshop of hose installation and user groups. Fault-tree diagrams use logical operators, principally the ‘‘OR’’ and ‘‘AND’’ gates. In AND gate the output event occurs if any of the input events occur. This describes the intersection of the sets containing all input events to that gate. The out put from an OR gate occurs if one of the input events occurs. This describes the union of the sets containing all input events to the

Table1 Parameters of the collected data of hose EN853-2SN

1	applications	High pressure hydraulic system
2	Inner tube	Synthetic rubber resistant to oil
3	reinforcement	Two braid steel wire
4	Outer covering	Synthetic rubber resistant to abrasion, fire etc

Hydraulic hose fault tree analysis containing failure as external damages are contributed by the pulling ,twist and crushing .hose when operates above the working pressure its life decrease frequently high temperature become favourable to hard the tube attack develop corrosion the inner tube and degrades strength .incorrect coupling used ,end coupling blows failed system ,hose covers damages by cuts ,abrasions ,hose burst due to exceeded and leaks develops ,flexing of hose during a period of high cold stiff the tube. chemical the working pressure .when hose used for not compatible with material being transferred cause failure .in the fault tree of hydraulic hose many codes used as cause of failures.1.Extream heating of hose[EHH] 2.damage o rings[DOR]3.lose hose coupling[LHC]4.extream hose cold[EHC]5.fluid absorbed in hose[FAH]6.fluid not compatible in hose 7.Execeed working pressure[EWP] 8.execece minimum angle[EMA]9.hose inclusions[HI]

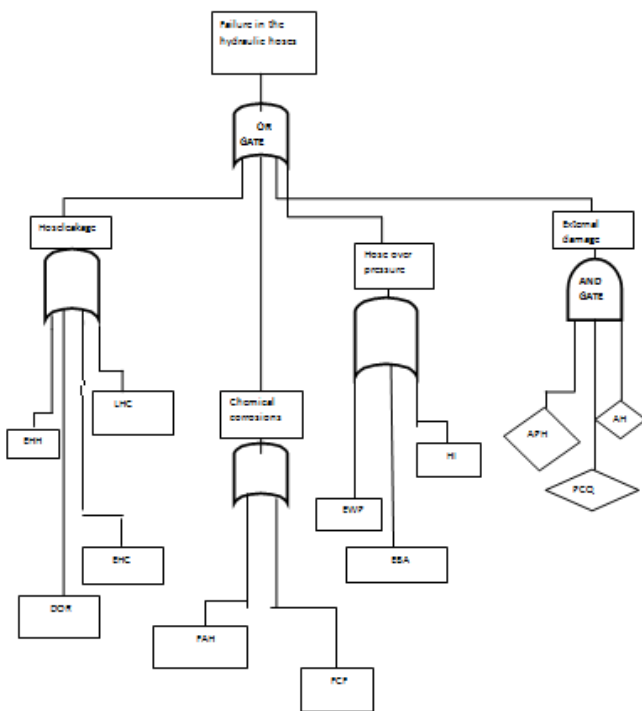


Figure no 3.fault tree of hydraulic hose

Fault tree analysis is based on our inspections and hose installation experts of different sizes of high pressure failure n working fields as JCB

Table2.

Sr .no	Main events of hose failure	Contribution of failure (%)
1	Hose leakage	8-10
2	Chemical attacks	3-5
3	Manufacturing mismatch	2-3
4	Hose overpressure	10-15
5	External damage	70-80

Above table2.is presents the main events of hose failure and their contribution of failure in hydraulic hose assemblies .these information we have collected from hose users and installation experts in various earth moving system .hoses are cheaper than their cleaning and maintenance cost but it is hazard due to fluid exposed in working area and their system.

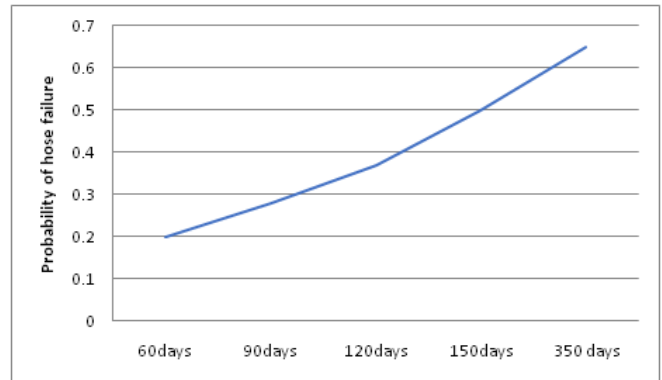


Figure no 4. probability of high pressure hose failure

IV. CONCLUSIONS

Hydraulic hose used in failure analysis and identification of cause of failure in earth moving machines .we have collected the experts advice and hose installation workshop failure worksheet. after analysis the available resource we have determined that EN853-SN type hose that is high pressure hose used in excavators ,skid loaders ,earth – moving machines .most of the failure occurs through the external damage it is examined that 60-75 percentage hose failed by the external damage and due to rest end hose coupling ,hose burst, cracks there are following preventive recommended 1.all hose and coupling should be hydrostatic tested at regularintervals 2.cheacks the hose working pressure 3.identify the material and temperature as application required

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