MATHEMATICAL MODELLING FOR THE AGING OF TECHNICAL SYSTEM

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Introduction : -

▶ Aging of materials is commonly based on its material properties whereas aging of technical system is depend on its application.

▶ Aging phenomena is directly related to wear of material or failure of system which highly requires a method to predict the failure.

▶ For this requirement mathematical modelling is used to predict the age of any technical system. Several authors presented their work by means of mathematical modelling to define the aging of system.

▶ After modelling the aging system, its reliability is main factor which is to be define to execute the model to predict the aging. hence reliability of these probability models plays an important role to predict the aging.

Summary & the result presented in the previous semester: -

- In the previous semester, me and my supervisor Dr. Pokorádi Laszlo, published a journal which is "AGING OF TECHNICAL SYSTEMS – LITERATURE REVIEW" in production engineering Journal.

- In this paper literature of aging of technical systems is studied briefly. I found 2 major topics. Which are maintenance management and mathematical modelling. Based on this, their connections with other important key factors was briefly studied in the field of aging. In this review, I comparatively discuses all the methods and their theories.

- To find the lifetime reliability of technical system and it's modelling with effective methods is the main aim of this paper. Which is summarized and presented briefly.

Results of the actual semester: -

- In the recent semester, I gave a direction to our previous work which is to make a mathematical model to define the aging by means of Markov process.

- Two main suggestions are given to calculate the reliability for the independent probability models, one is the recursive equation approach, and the other is the Markov chain approach. Aging is the stochastic process and hence due to this phenomena aging can be predicted by means of Markov process.

- In this study of Markov process and their application based on aging, several studies and research is made. Literature is reviewed briefly. In this particular study I thoroughly presented all the Markov process and their application to find the aging of a technical system. On the basis of this presented data I can find the optimal way to predict the age and can study the previous work which is done by different authors.

Results of the actual semester: -

▶ The main aim of the paper is to discuss the Markovian processes, their application and the best effective method to do age modelling of a technical system.

▶ This paper is based on 2 things which are aging of materials and aging of whole technical system by means of Markov process.

▶ The structure of this paper stands on the prediction of aging of technical system by means of mathematical modelling which follows Markovian processes.

▶ I made a Markov based model with the help of MATLAB. This Markov model is coded to illustrate the probability of aging states over time. The aging data will be used to get the final result with the help of this Markov model.

Results of the actual semester: -

▶ There are 2 subjects which was studied in this semester.

1. Impairment of structural materials

2. Fracture mechanics

▶ I studied about the fracture mechanism of different materials and their results based on their structure.

▶ Basically, fracture is varying as per material's structure. Fracture toughness testing is studied and it is a main factor to evaluate the toughness results. Fracture toughness is basically depending on material's thickness.

Results of the actual semester: -

▶ In the other contrast fracture behavior is also studied and connected it with the practical testing of selected material.

▶ The cracking process occurs slowly over the service life from various crack growth mechanisms such as fatigue, stress-corrosion cracking, creep, and hydrogen-induced cracking.

▶ With the help of Scanning electron microscope and transmission electron microscope, these kind of fracture can be examined. Optical microscopy can also be of use for examining large inclusion particles.

Results of the actual semester: -

► Precipitation of hardening alloys, such as those of aluminum, can be expected to have dispersed fine precipitates that may range from spherical to platelet.

► Hence to investigate more I decided to use Aluminum based alloy which is AlMgSi (6082-T6) for further practical investigation.

► I format this study to publish an article to show the aging of selected materials which is Aluminum alloy.

► I conducted aging test on Al-Mg-Si alloy which is 6082-T6 Al Alloy. 6082 aluminum alloy is an alloy in the wrought aluminum-magnesium-silicon family. It cannot be work hardened, but it is commonly heat treated to produce tempers with a higher strength but lower ductility.

► The aim of this study is to evaluate the aging of this particular aluminum alloy and compare it with other alloys of this family.

Future framework: -

▶ The future framework of ongoing research is to simulate the presented Markov model by means of Monte carlo simulation.

▶ This Markov model research will be published in upcoming days.

▶ This research will continue to connect with the manufacturing technology of the industry 4.0.

▶ Finite element modelling of the material technologies will be taken into consideration for future research work.

THANK YOU.