Formulation of Generalized Approximate Field Data Based Model for Air Compressor Overhauling of Diesel Locoshed

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Abstract : The paper details the productivity improvement and quality of maintenance of air compressor at Diesel Locoshed. The Diesel Locoshed had been established in 1964. There are two types of maintenance attended here periodical and breakdown. Air compressors are used in these locos to maintain 10 kg/cm2 air which are used for loco breaking and loco running systems like fuel supply control through governor and hydraulic transmission system. The improvement in overhauling of air compressor improves the periodical maintenance schedules which save precious time and increase efficiency.
The present paper reports on the field investigation carried out in regard to air compressor overhauling operation used in the Diesel Locoshed. An approximate generalized field data based model is evolved for Improving Productivity and Maintenance Quality.

IndexTerms - **Maintenance, Productivity, Diesel, Air compressor, Mathematical Model**

I. INTRODUCTION

In the present method the productivity is less and requirement of human energy is substantial. Therefore, the factors influencing the overhauling of air compressor have been identified, so as to optimize the productivity and conserving human energy in this activity. The generalized mathematical model has been formulated using theories of experimentation for the overhauling of air compressor. Field data based model for a man machine system will decide strengths and weaknesses of present method of performing any maintenance activity. Once weaknesses are known corrective action can be decided.

A theoretical approach can be adopted if a known logic can be applied correlating the various dependent and independent parameters of the system. Though qualitatively, the relationships between the dependent and independent parameters are known based on the available literature references, the generalized quantitative relationships are not known sometimes. Hence, formulating the quantitative relationship based on the known logic is not possible. On account of little possibility of formulation of theoretical model one is left with the only alternative of formulating field- data based model. Hence, it is proposed to formulate such a model in the present investigation [1-2].

II. MODEL FORMULATION

The main objective of the present research work is to establish the quantitative relationship of the interaction of the inputs on the response variables of air compressor overhauling techniques of diesel locoshed. Normally, the approach adopted for formulating generalized field data based model suggested by Schenck H. Jr., has been proposed in the present investigation which involves following steps:

Identification of variables or parameters affecting the phenomenon
Reduction of variables through dimensional analysis
Direct data collection for the activity from work station (Test data)
Rejection of absurd data
Formulation of the model

When it comes to the formulation of the model, there is no other substitute, but to adopt the methodology of experimentation. The inputs to the phenomenon, the outputs and the extraneous variables are identified as shown in table 1. The inputs are experimentally varied over a broad yet practically possible range and the response data is collected. Applying properly the suggested methods, the effect of extraneous variables is minimized. On the basis of the gathered data the models are formed [3-4].

Table 1 : Independent and Dependent Variables

Sr. No.	Description	Types of variables
01	Pulse rate	Independent
02	Illumination(I)	Independent
03	Ambient temperature(θ)	Independent
04	Ambient temperature	Independent
05	Stature	Independent
06	Shoulder Height	Independent
07	Elbow Height	Independent
08	Eye Height	Independent
09	Finger tip Height	Independent
10	Shoulder Breadth	Independent
11	Hip Breadth	Independent
12	Head Breadth across thumb	Independent
13	Relative Humidity(ø)	Independent
14	Spanner	Independent
15	Pipe wrench	Independent
16	Screw Driver	Independent
17	Pressure	Independent
18	Age of worker	Independent
19	Experience of worker	Independent
20	Skill of worker	Independent
21	Enthusiasm of worker	Independent
22	Habits of worker	Independent
23	Time of overhauling	Dependent
24	Human energy	Dependent

It was also decided to establish the quantitative relationship of the interaction of these inputs mentioned above on the time of overhauling, and human energy consumption during the air compressor overhauling activity of diesel locoshed [5-7]. These independent variables have been reduced into group of π terms [8]. List of the Independent & Dependent π terms of the overhauling activity are: π1=Anthropometric dimensions of the worker, π2=Specifications of maintenance tools, π3=Specifications of process parameters, π4=Ambient temperature, π5=Relative humidity and π6=Illumination and πD1=Time of overhauling, πD2=Human energy consumption for overhauling

Six independent π terms (π1, π2, π3, π4, π5, π6) and two dependent π terms (πD1, πD2) have been identified for field study model formulation [9-10].

Each dependent π term is a function of the available independent π terms,

Td = f(π1, π2, π3, π4, π5, π6)

He = f(π1, π2, π3, π4, π5, π6)

Where,

Td = πD1, First dependent π term= Td

He = πD2 , Second dependent π term= He

f stands for "function of " . The probable exact mathematical form for the dimensional equations of the phenomenon could be relationships assumed to be of exponential form.

The exact forms of models obtained are as under:

T = K{[(P1)]a1,[P2]b1,[P3]c 1[P4]d1,[P5]e1[P6]f1}

He = K{[(P1)]a2,[P2]b2,[P3]c21[P4]d2,[P5]e2[P6]f2}

To determine the a1, b1, c1, d1, e1and f1 in equation, so that:

$T=K1*[(\pi1)\ a1*(\pi2)\ b1*(\pi3)\ c1*(\pi4)\ d1*(\pi5)\ e1*(\pi6)\ f1]$ (1)

$He=K2*[(\pi1)\ a2*(\pi2)\ b2*(\pi3)\ c2*(\pi4)\ d2*(\pi5)\ e2*(\pi6)\ f2]$ (2)

III. MODELS DEVELOPED FOR DEPENDENT VARIABLES

The Readings have been collected at work stations with a team of different workers at each location at different timings [11].

The exact forms of models obtained are as under:

$T = 1.98*(\pi1)\ 2.23*(\pi2)\ 1.12*(\pi3)\ 1.98*(\pi4)\ 0.70\ *(\pi5)\ 0.72*(\pi6)\ 0.53$

$He = 1.58*(\pi1)\ 1.42*(\pi2)\ 0.54*(\pi3)\ 0.14*(\pi4)\ 0.85*(\pi5)\ 0.27*(\pi6)\ 1.47$

In the above equations (T) is relating to response variable for time of overhauling activity and (He) is relating to response variable for human energy consumed in the overhauling activity.

IV. RESULT AND DISCUSSION:

Analysis of the Mathematical models showed that the influence of Anthropometric data of the worker and ambient temperature on the time of overhauling is significant and increases with increase in ambient temperature. The response variable time of overhauling decreases with improvement in Illumination, ambient air velocity in the work station. The response variable Productivity increases significantly with reduction in ambient temperature and relative humidity. The response variable Human Energy Consumed in overhauling operation is significantly dependent upon Anthropometric data of worker.

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