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Pay Back Period of New Motors & Losses Comparison with Rewound Induction Motors Used In Rice Mill

Ramanpreet Singh[1],Jasvir Singh[2],RamandipSingh[3]
Research Scholar M. Tech (E.E. Deptt.) B.G.I.E.T, Sangrur (Pb)[1]
Assistant Professors,(E.E.Deptt)B.G.I.E.T Sangrur(Pb)[2&3]

Abstract: *To reduce energy consumption in any industry, it is necessary to determine the efficiency of rewound induction motor and compare it with the rated efficiency of that motor. If the efficiency of rewound induction motor is found near to the rated efficiency of that motor, then there is no need for any change. If the efficiency of rewound induction motor is found low as compared to rated efficiency of that motor, then it is better to replace that motor with new one. This paper explains the pay back period of new motors and its losses comparison with rewound motors.*
Keywords: *Rewound induction motors, Rice mill, efficiency, energy losses, payback period.*

I. Introduction

The major source of energy consumption in an industry is electrical motors. About 75% of energy is consumed by induction motors in a Rice mill. It is a common practice in any industry to rewind the induction motors in case of any fault. This decreases the efficiency of a motor and increases the energy losses and hence the energy consumption in any industry. Thus, it is better to replace the rewound induction motors with the new ones.and comprison of losses show the more energy consumed by rewound motors as compared to new motors. The pay back period of new motors also calculated.

II. Problem Definition

In the Rice mill, the rewound induction motors of different horsepower are to be studied for different types of losses so as to determine the overall efficiency of the induction motors. Then, these efficiencies are compared with the efficiencies of new induction motors. After that, it has been found that it is better to replace the rewound induction motors with the new ones as the payback period is found to be existing in the range of 1.5 years to as less as 7 months.

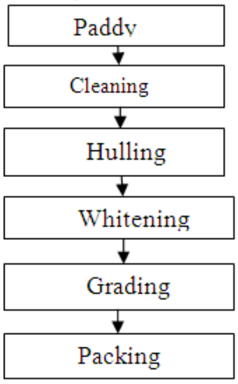
III. Method

After visiting in the rice mill so many times, several rewound induction motors are identified. After that, it is being examined that how the machines are working. Then all the parameters (rated, measured and calculated) of the motors are recorded through different measuring instruments. These parameters are then used for determining the efficiency of the induction motors. The equipments used for the measurements of induction motor parameters are described in table 1.

Table-1 Parameters and Measuring Instruments used

Parameters	Measuring Instruments
Voltage	Power Analyzer
Current	Clamp On Transducer
Input Power	Power Analyzer
Speed	Tachometer
Winding Temp.	Resistance Temperature Detector
Winding Resistance	Power Analyzer

Fig.1 is showing the process of rice mill



IV. Results And Discussions

The energy can be saved by means of replacing the rewound induction motors with the new ones so as to increase the efficiency of the motor. Rated parameters of one of the induction motors are shown in table 2.

Table- 2 Rated Parameters

No. of Phases	**03**
No. of Poles	**04**
Rated Power(HP)	**15**
Rated Voltage, (Vrated)	**415**
Rated Current, (Irated)	**20**
Full Load Rated Speed, (Nrated)	**1450**
Supply frequency, f (Hz)	**50**

Measured parameters of one of the induction motors are shown in table 3.

Table- 3 Measured Parameters

No-load voltage (V)	**415**
No-load current(A)	**8.5**
No-load input Power(W)	**524**
Winding Temp. of still motor, T1(°C)	**12**
Resistance at room temp., R1(	**0.52**
Winding Temp. of no load motor, T2(°C)	**38**
Winding Temp. Of loaded motor , T3(°C)	**138**
Supply frequency, f (Hz)	**50**
Full load voltage, $V_{full\text{-}load}$(V)	**415**
Full load current, $I_{full\text{-}load}$(A)	**20.5**
Full-load input Power, $P_{full\text{-}load}$(W)	**12500**
No-load Speed, N1(RPM)	**1480**
Full-load Speed, N2(RPM)	**1475**

V. Calculated Parameters

Synchronous speed, $Ns = \frac{120f}{p} = \frac{120 * 50}{4} = 1500$RPM

Stator resistance of no-load motor,

$R2=R1 * \frac{235 + T2}{235 + T1} = 0.52 \times \frac{235 + 38}{235 + 12} = 0.57\ \Omega$

Stator resistance of loaded motor,

$R3=R1 * \frac{235 + T3}{235 + T1} = 0.52 \times \frac{235 + 138}{235 + 38} = 0.71\Omega$

Stator cu. loss, Pst1 = (Ino-load)2 × R1 = 43.35 W

Stator cu. loss, Pst2 = (Ifull-load)2 × R2 = 231.1W

Iron losses, (Pi) = Pno-load – Pst cu loss at no-load = 480.65 W

No-load slip, Sno-load (%) = $\frac{Ns - N1}{Ns} * 100 = 1.33$

Full-load slip, Sfull-load (%) = $\frac{Ns - Nfl}{Ns} * 100 = 1.67$

Full-load rotor losses, Protor = (S×P2) = 196.60 W

Stray losses= 1.5% of full-load input power =187.5W

Full load output power = $P_{full\text{-}load}$ – Pstator – Piron – P_{stray} – P_{rotor} =11585.51

Efficiency at full-load, , ηfull-load = ($P_{output}/P_{full\text{-}load}$) × 100= 92.68%

Rated Efficiency= 93.25%

Analysis done on few rewound motors according to the formulae described above is shown below in the form of graphs:

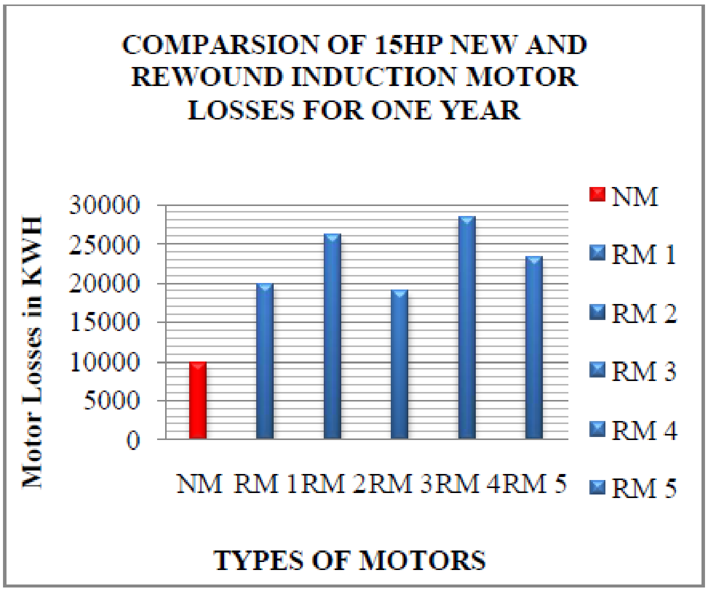


Fig.2 15HP Motor Losses Analysis For One Year.

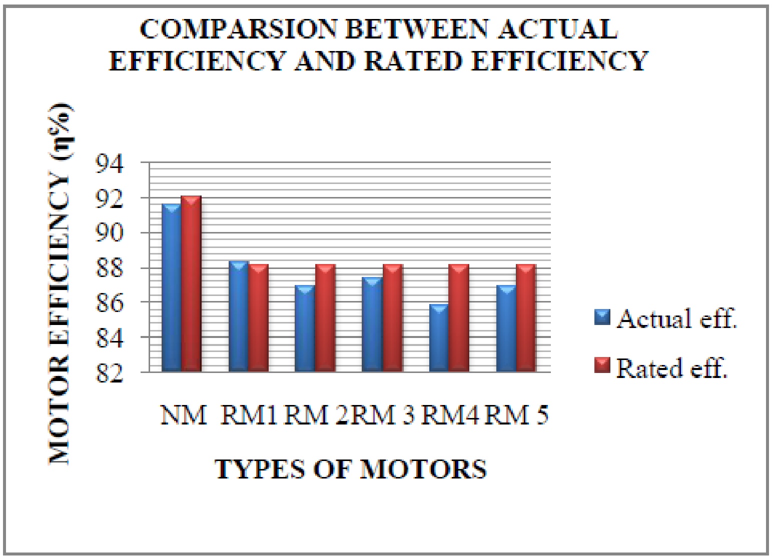


Fig.3 15HP Motor efficiency Analysis.

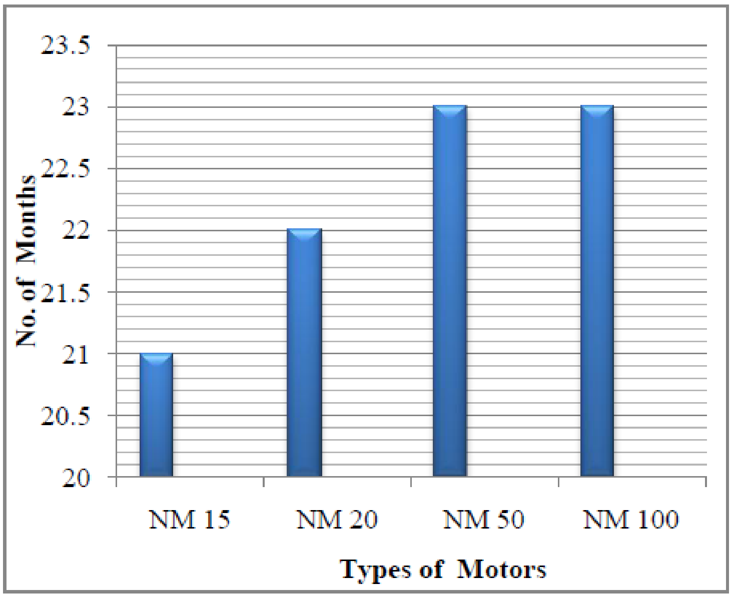


Fig.4 Payback Period Analysis Of New Motor

After doing analysis of rewound motors, it is recommended to replace the motors with new motors. It is noticed after analysis that there exists a relationship between motor horsepower and its payback period. The relationship is stating that with the increase of the motor size its payback period decreases.
Hence, it is recommended to replace the large horsepower motors than to make them rewound.

VI. Conclusion And Future Scope

The most energy conservation area is analyzing the rewound motors and after analyzing, it was found that the losses of new motor is 10000 KWH better then the rewound motor, which has losses 20000 to 30000KWh. Capacitor bank of determined size can also improve the system efficiency. The losses of the system are reduced. Hence play an important role in conservation of energy. A future study on power factor improvement analysis and improvement is thus suggested.

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