

ENERGY EFFICIENT COPPER DI CAST ROTOR MOTORS

AN OVER VIEW

Presented By

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MEHALA MACHINES INDIA LIMITED

First in Asia to make Copper Die cast Rotor EE motor.

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Decade old 1 HP standard conventional motor at Minimum Efficiency 65 % running in our industry versus New EE motor maximum Efficiency 82.5 %

Electrical Systems
2008

Energy Efficiency
in Electrical
System

Range (H.P)	% of Loss	At FL efficiency %
1-10	14-35	65-86
10-50	09-15	85-91
50-200	06-12	88-94
200-1500	04-07	93-96
1500 & above	4	95-96

❖ Approach -1 :

Downsizing motor

- Matching requirement
- Improved loading – Improved efficiency
- Possible energy savings <5%
- Max efficiency for low capacity motors less

Motor – The Wise Reason behind its Replacement, You take Today

The 4 conditions why motors need to be **relocated** or **repaired** or **replaced**

1. Motors need to be **sized to load**
2. Improved motor efficiency by **new technology** can be adopted
3. Existing motor found **less efficient**
4. The existing motor winding or rotor is **unreliable**

EE motor – what are the ways & areas of improvement adopted by the OEMs?

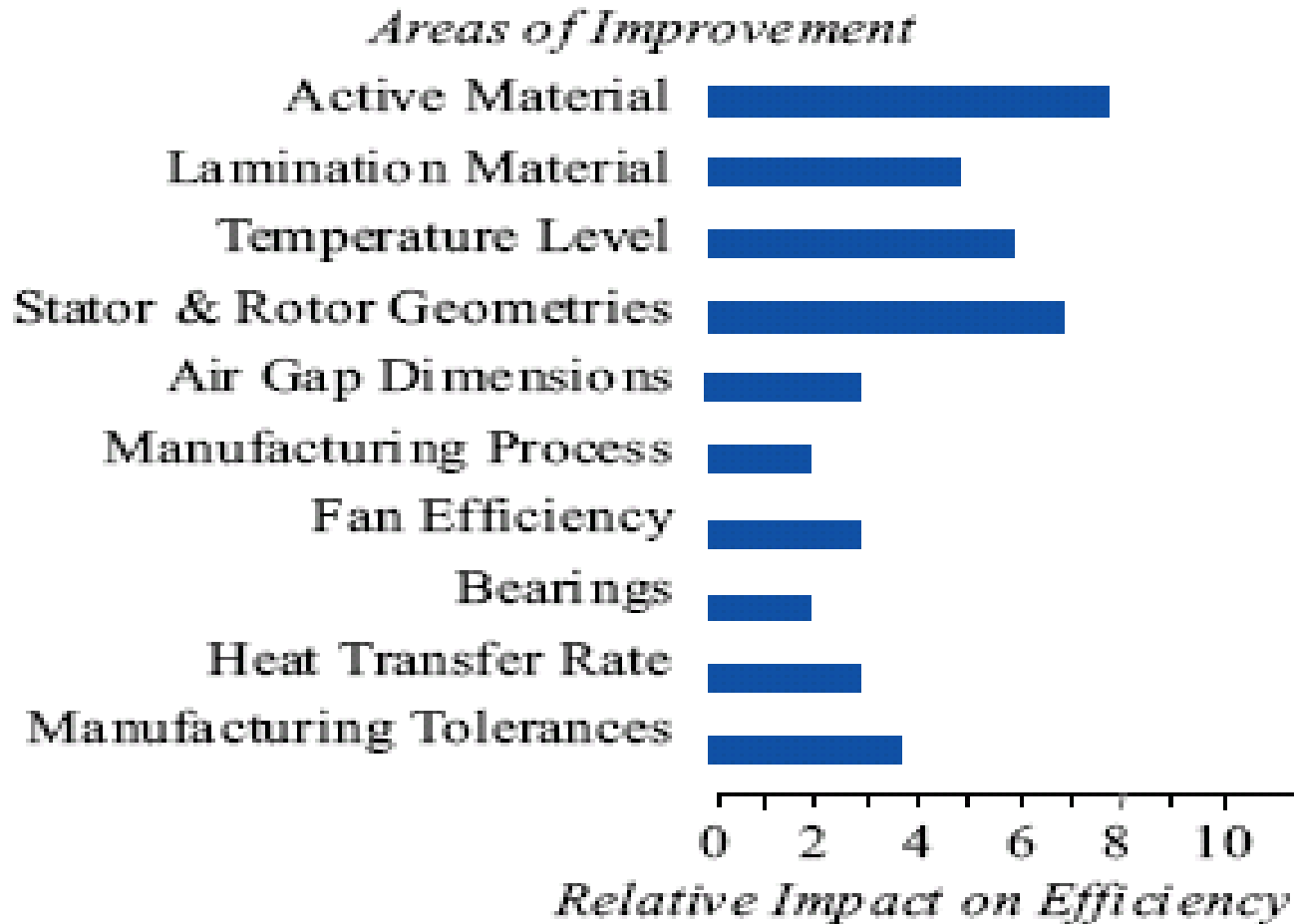


Fig. 2. Impact of the possible areas for improving the motor performance

HOW EFFICIENCY OF MOTOR IS IMPROVED?

- **Reduction of Iron Losses**
- **Reduction Stator Copper Losses**
- **Reduction Rotor Copper Losses**
- **Reduction Stray Losses**
- **Reduction Friction and Fan Losses**

INDUCTION MOTOR -TYPES OF ROTORS

- **The Squirrel Cage Construction started with Copper Bars and brazed End Rings**
 - **Cumbersome process**
- **Aluminum Die-cast Rotors**
 - **Easy to make and cheaper**
- **Copper Die-cast Rotors**
 - **For higher efficiency**

REDUCTION OF ROTOR LOSSES

- Increasing the size of rotor bars
- Increasing the cross section of shorting rings
- *Using copper die-cast rotor in the place of Al. die-cast rotor*

RESULT OF USING LOW LOSS STAMPING / INCREASED CONDUCTOR AREA

11kW 1500 rpm	Standard Design	Low Loss Stamping	Plus Added Cu
Iron losses	455W	330 W	255 W ↑
Friction & Windage	120W	120W	120W
Constant Losses	575W	450W	375W
Load related Losses	925W	925W	850W
Total Losses	1500W	1375W	1225W
Efficiency	88.0%	88.9%	90.0%

Energy Loss – Visualize in your existing motor 30% more losses gone till yesterday. Why not you start saving today please?

By replacing with our Cu-Die EE motor

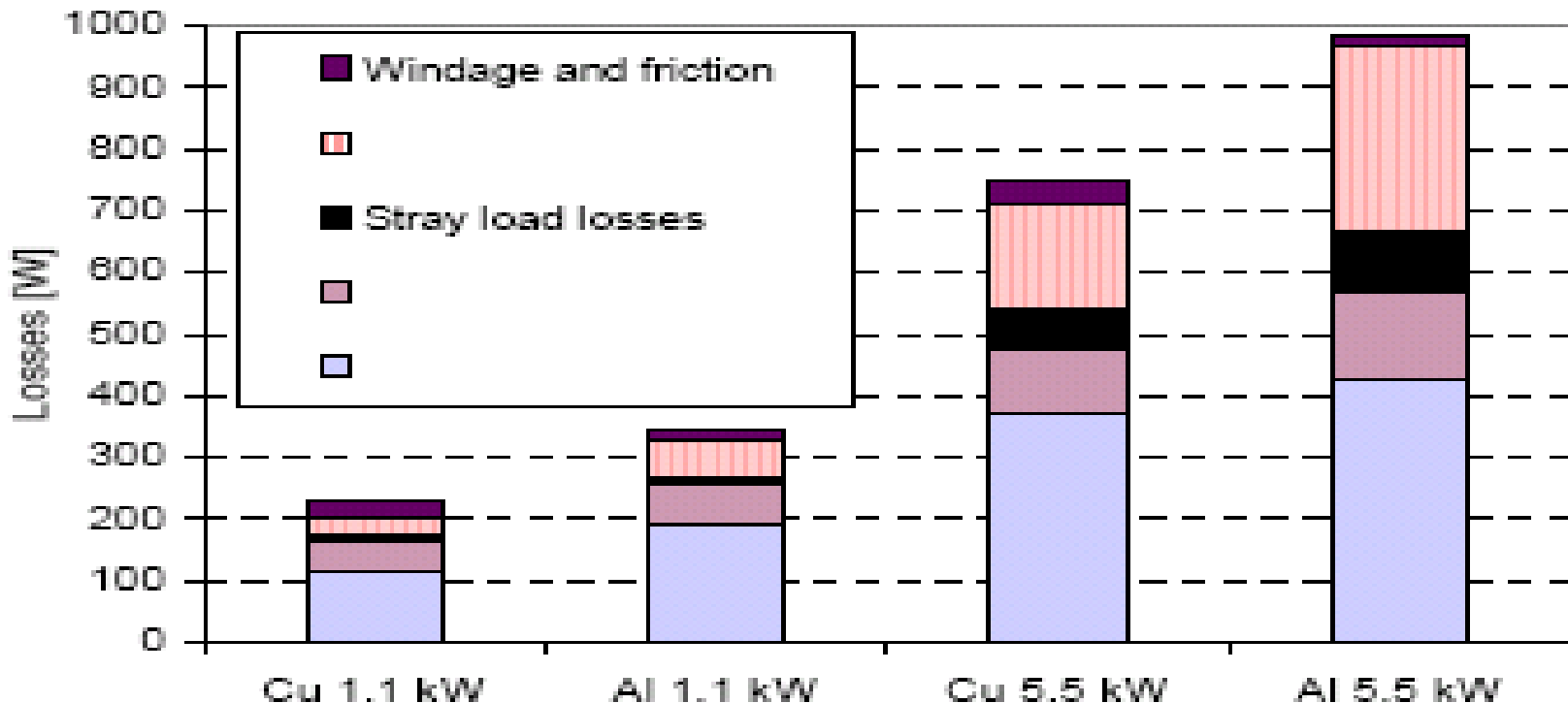


Fig. 1. Loss distribution at 50 Hz.

ADCR VS CDCR MOTOR EFFICIENCY COMPARISON CASE STUDY RESULTS:-

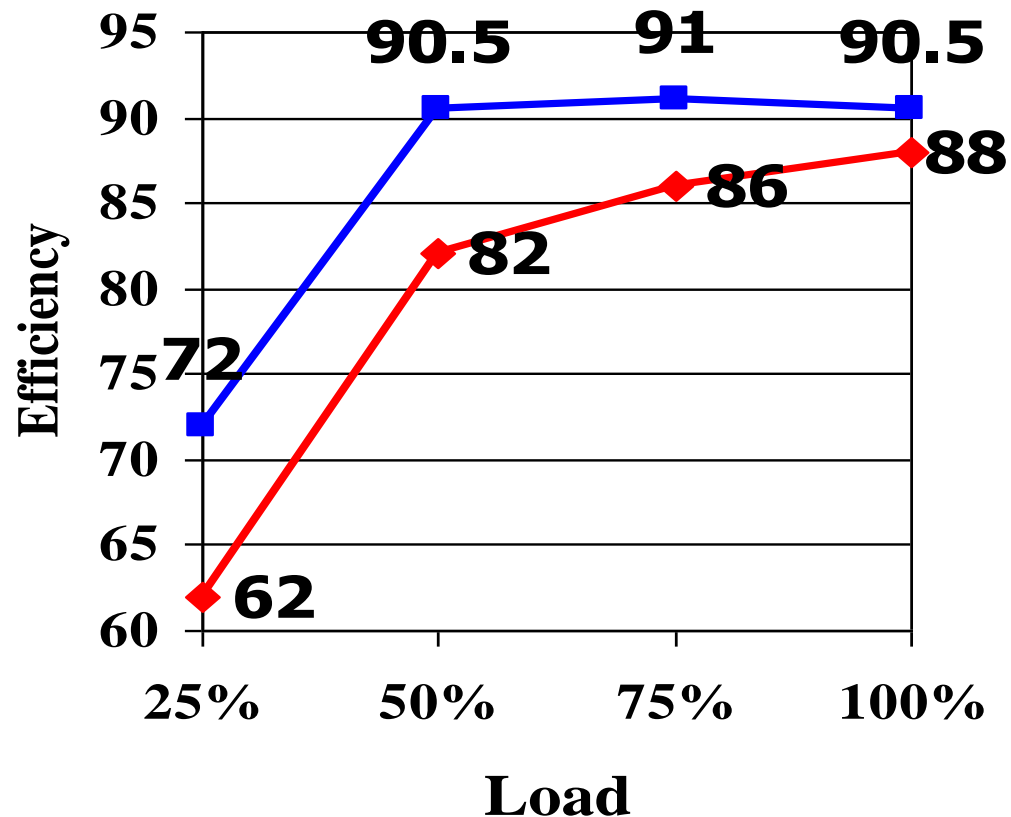
Source : Mehala Machines India Limited

Motor Rating kW / Pole	Efficiency With Al. D/C Rotors %	Efficiency With Cu. D/C Rotors %	Efficiency Increase in %
0.75 / 4	73.2	82.6	9.4
1.1 / 2	76.4	83.0	6.6
2.2 / 2	81.6	86.0	4.4
2.2 / 4	81.4	86.5	5.1
3.7 / 4	84.2	89.0	4.8
7.5 / 4	87.2	90.2	3.0

EE MOTOR EFFICIENCY- FLAT CHARACTERISTIC

Curves shown for **std & energy efficient 11kW 4P motor**

- The **LOADING VS EFFICIENCY** curve of EE motor is flat from 50% to 100% load.
- The maximum efficiency is attained at 75% load around which most of the motors are expected to operate.



◆ Std motor ■ EE motor

EFFICIENCIES OF EE MOTORS

Efficiencies of 4 pole Motors compared

Output (KW)	Existing motors (Avg)	IS 12615('04)	
		Eff 2	Eff 1
0.75	71	73	82.5
1.50	76	78.5	85
3.7	83	84	88.3
7.5	85	87	90.1
11.0	85.5	88.4	91**
18.5	87	90	92.2
37.0	88.5	92	93.6

**** CEMEP 91% NEMA 91% NEMA Premium 93%**

Efficiency values are subject to tolerance as per IS 325



Motor efficiency is talked with respect to standards only.

IEEE 112 B stringent standard gives the difference in efficiency between Alu –Die and Cu-Die motors.

**FULL-LOAD EFFICIENCIES BY IEEE 112-B
FOR HIGH EFFICIENCY MOTOR SERIES DTE/DVE
AND STANDARD EFFICIENCY SERIES DT/DV**

		50 Hz	60 Hz
Copper Rotor Motors			
DTE90S4	1.1 kW	82.8 %	84.1 %
DVE132S4	5.5 kW	88.1 %	89.7 %
Aluminium Motors			
DT90S4	1.1 kW	75.7 %	77.4 %
DV132S4	5.5 kW	84.8 %	86.6 %

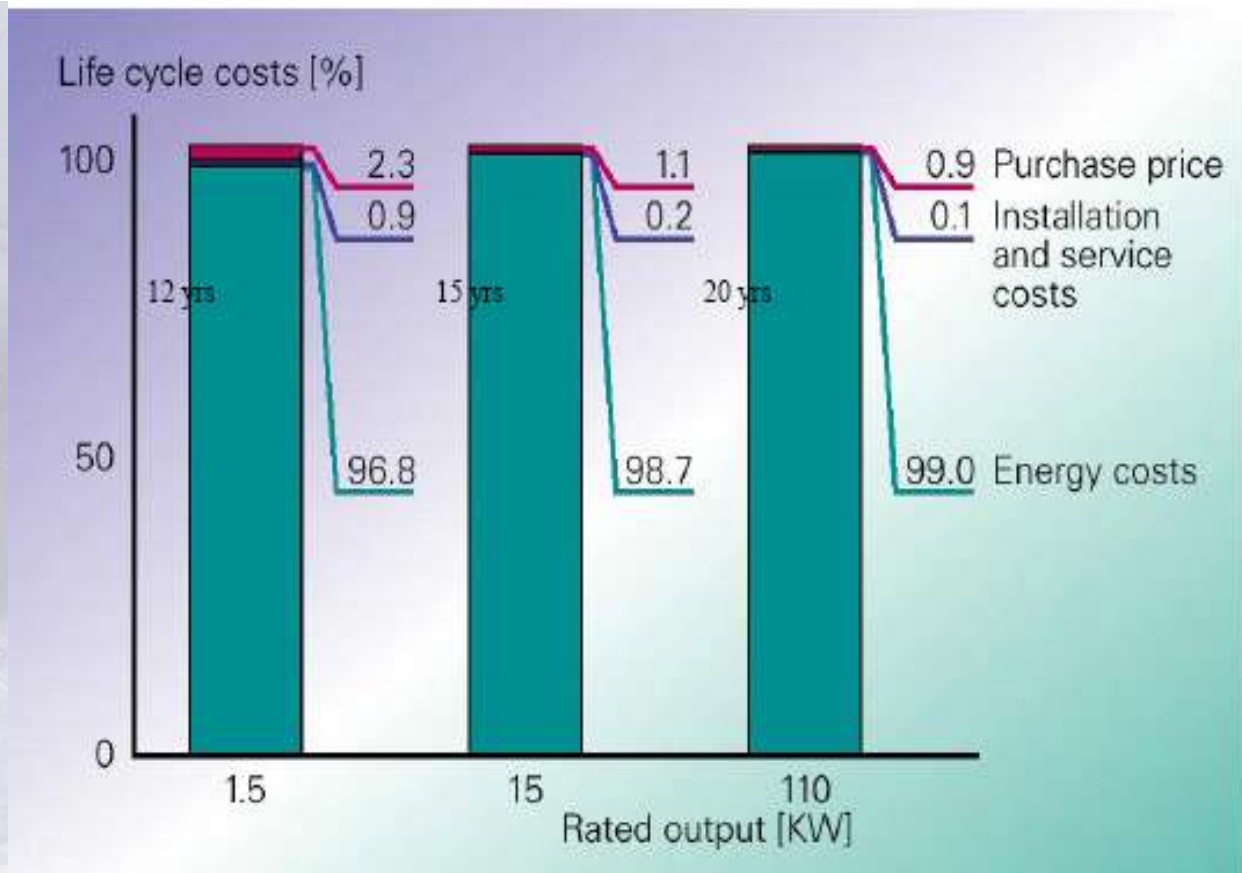
DCR ROTORS CAST LOCALLY



EE MOTORS – DO WE LAG BEHIND BY A DECADE ?

- **Minimum efficiency level mandatory at Eff 1 in USA almost a decade ago.**
- **Thanks to EC act 2001, that we lag behind only a decade!**
- **Labeling of motors mandatory by 2007 and BEE is on the job.**
- **Government should encourage EE motors with preferential purchase and thro` input subsidies.**

Motor – Please don't go for Cheap cost Motor When you see a motor Visualize its Running Cost for a Decade and Buy



The low cost of buying can be deceptive

Present Electricity cost catalyzes the user to switch over copper die cast rotor for Low HP motors in our industry today.

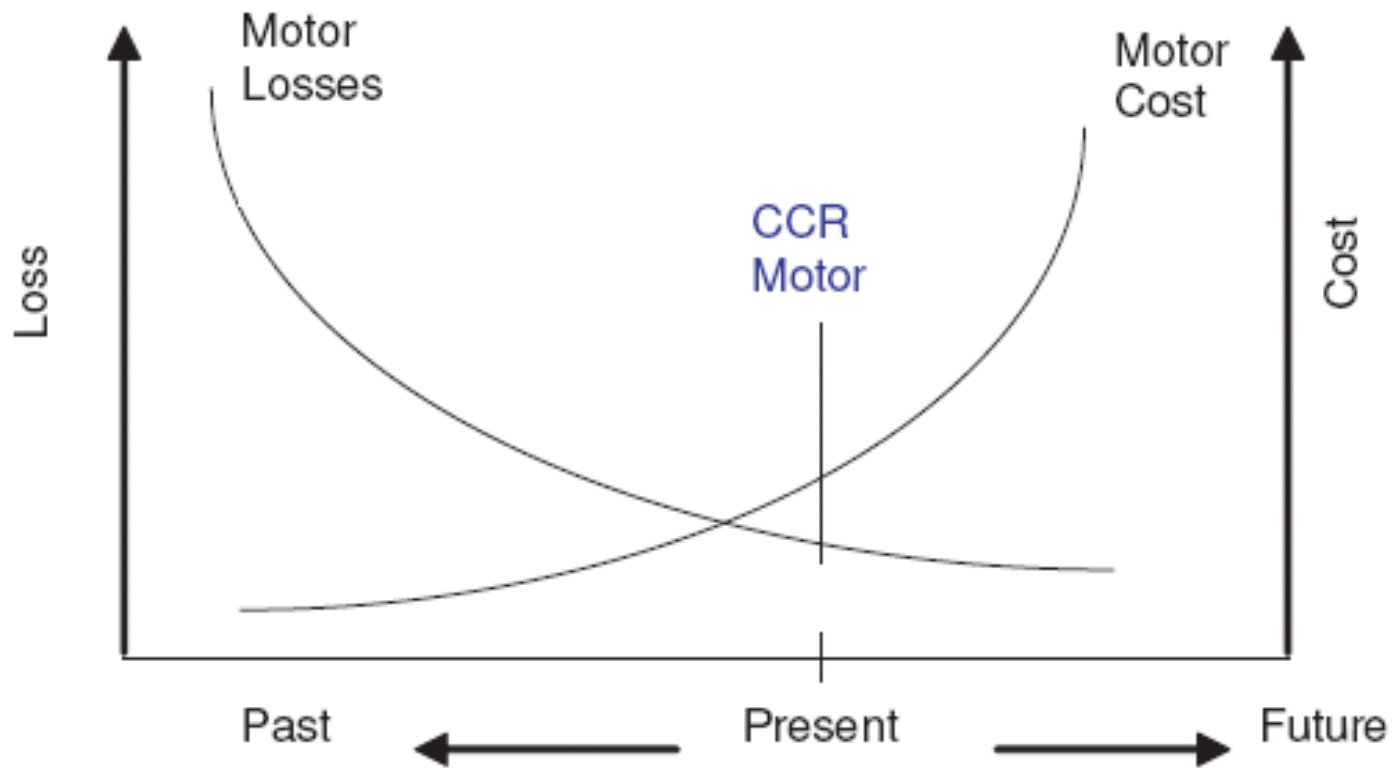


Figure 1: Induction motor efficiency, technology and cost [Deivasahayam, 2005]

*Invest little more on our EE motor today and
get Annual Returns from now on.*

Invest Rs.3500/- for 1 hp Mehala EE motor you get Rs.4900/-

MORE in one year that is the RETURN in First year – ROI

This Rs.4900/- is a Bonus for you year after year for 20 years

(Working $0.118 \text{ UPH} \times 23.5 \text{ hr} \times 360 \text{ days} \times 4.9 \text{ Rs./unit}$ Rs.4900/-

Compared to Rs.2900/- on any 1 hp new improved effy eff2 motor.

Payback on Mehala EE motor over X motor is 8 MONTHS.

Replace your de-rated 10 year old conventional motor depending

on its efficiency, pay back will be **around 4 - 6 months.**

Do you motor give flat & peak efficiency during its loading operation?

Our Cu-die motor gives flatter efficiency

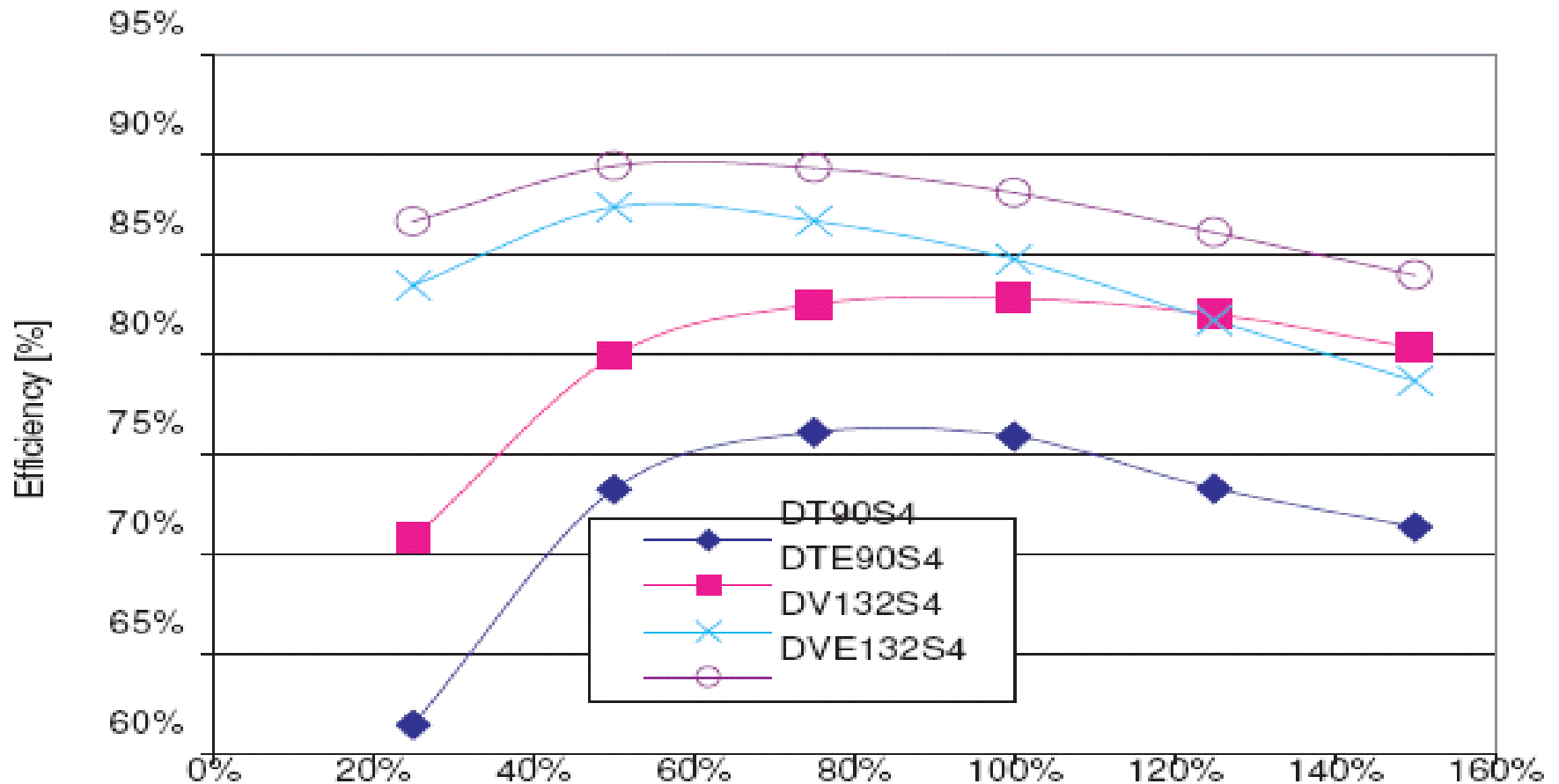


Figure 2: Efficiency vs load, 1.1 and 5.5 kW

Hotter motor is symptom of energy loss

Our Cu-Die motor Rotor temperature regulation plays a direct and critical role in increasing insulation Life and in turn motor life and reliability.

www.leonardo-energy.org

Motors with Die-Cast Copper Rotors

Rotor conductor	Al	Cu	Al	Cu	Al	Cu	Al	Cu
Rated power, kW	1.1	1.1	5.5	5.5	11	11	37	37
Power factor	0.77	0.79	0.83	0.83	0.83	0.81	0.87	0.85
Power consumed, W	1435	1334	6485	6276	12590	12330	40700	39900
Efficiency, %	75.9	82.8	84.8	88.12	87.6	89.9	91.1	93.2
Temperature rise, K	61.1	27.8	80.0	61.3	75.0	62.1	77.0	70.4

Table 3: Test data and performance characteristics [Kimmich, 2005]

Indirect benefits on choosing Cu-Die rotor motors = increase in productivity

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Table 7. Comparison of various performance parameters between DCR and die-cast aluminium rotors

Parameters	Variation Factor
Reduction in slip	2%
Increase in starting current	10%
Decrease in starting torque	17%
Improvement in Efficiency	2.8%
Decrease in Temperature	7.50 °C
Decrease in Full load Current	4%
Change in Full load p.f	Negligible

EE MOTOR IS COST EFFECTIVE. WHEN?

- **Running hours exceeds 4000 hrs per annum**
 - **Increase in output of driven equipments due to higher r.p.m in our MOTORS**

That is your PRODUCTIVITY IS UP FOR THE SAME SIZE OF MOTOR YOU ARE REPLACING NOW.

- **If extra output is not necessary, impeller/fan blade to be trimmed suitably**
- **Large number of higher capacity motors are used and electricity charge increases**

REVIEW ON EFFICIENCY IMPROVEMENT IN SQUIRREL CAGE INDUCTION MOTOR BY USING DCR TECHNOLOGY

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POTENTIAL BENEFITS WITH DIE-CAST COPPER ROTORS

- **Reduced losses by 15-20 percent,**
- **increasing nameplate efficiency by at least 1.5 to 3 percentage points**
- **Reduced manufacturing costs via less material per unit**
- **Reduced operating temp by 5-10degrees, which could extend motor life**

Focus area to replace your motor –

The Existing 10 year old standard conventional Rewound more than once, has more invisible losses & needs urgent attention.

Till yesterday, it was Shock to you to accept to the losses.
Today, it is a Relief to replace with our Cu-Die EE motor.
Tomorrow, it will be a Delight to visualize the energy savings.

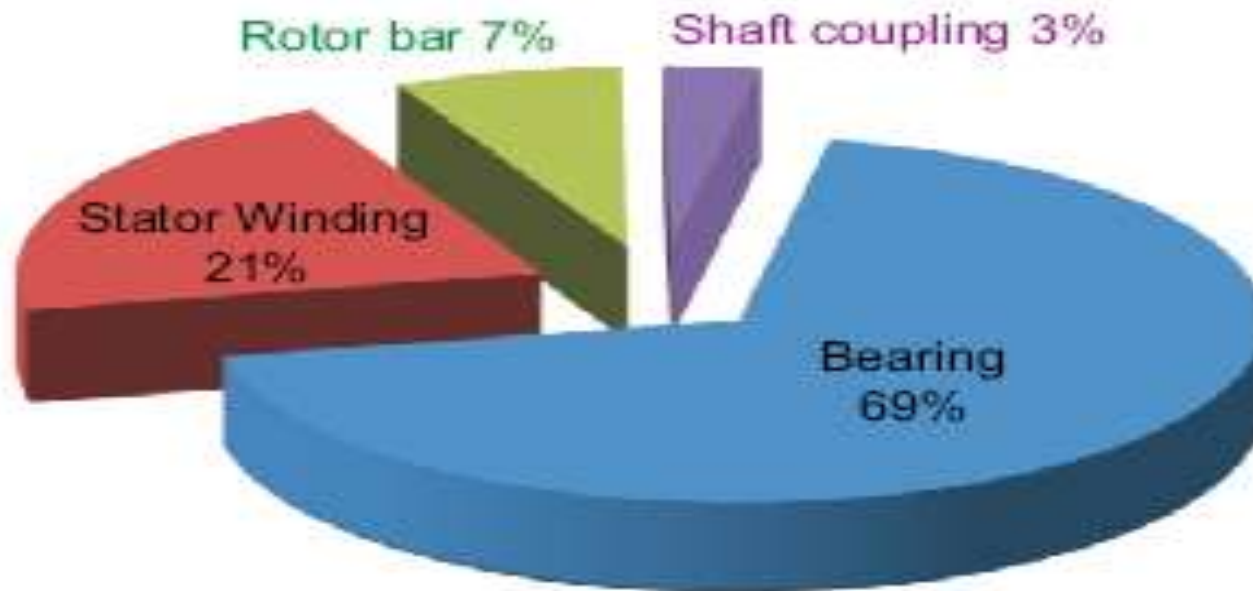


Fig. 5. Extrapolated distribution of failure by motor component

BEE Guidelines - Motor drive transmission - Visible losses in Belt Losses from motor to load
Please look for Overall Efficiency in system.

The efficiency of mechanical power transmission depends on grip between pulley and belt, further depends on μ (Co-efficient of friction) and strength (Tensile) of the belt. In case of

Table 3.4: Losses in V Belts

Sr. no.	Motor HP	Losses %
1	2	8-15
2	3	7-13
3	4	6-12
4	6	5.5-10
5	8	5-9
6	10	4.5-8.2
7	20	3.5-7
8	30	3.2-6
9	40	3-5.5
10	60	2.8-5
11	80	2.5-4.5
12	100	2.5-4.5

TEXTILE RELAX DRYER CENTRIFUGAL BLOWER LOAD	Existing Motor 7.5Hp / 1440 rpm	Orbito EFF1 CDCR 7.5Hp / 1460 rpm
(20 hrs X 26 Days X 12 Months)	HRS per Annum 6240 Hrs	6240 Hrs
Units Consumption per Hour 3 motors were tested. Taken Avg Measured by ALM 30 LOAD MANAGER	4.724 + 4.175+5.984 Avg = 4.961 KWH	4.175 units KWH
Energy Consumption KWhr/Annum	6240 hrs X 4.961 = 30956.64	6240 hrs X 4.175 Units = 26052
Energy Savings Units/Annum	----	4904.64 units pa
Cost of Energy / Unit	Rs.4.70	Rs.4.70
Cost of Energy saved / Annum	----	Rs.23051.80
Cost of Energy saved / Month	---	Rs.1920.98
Price of the Motor	Rs.10335.00	Rs.14738.00
Cost Difference (Excess)	---	Rs.4403.00
Interest for One year (12%)	---	Rs.528.36
Total Payable Cost extra for Orbito	---	Rs.4931.36
Recovery Period for Excess amount	---	2.6 months
Recovery period full cost of motor	---	7.67months

SPINNING DEPT EXHAUST MOTOR ENERGY STUDY

DEPARTMENT EXHAUST	STUDY - 1	
MOTOR MAKE	CROMPTON	ORBITO (CO- DIE CAST ROTOR)
DEPARTMENT	SPINNIG	SPINNIG
KW/HP	15 KW /20 HP	9.3 KW /12.5 HP
RPM	1440	1440
FRAME	ND160L	160M
RATED CURRENT	27.6	16.54
LOAD AMPS average R Y B	18.49	16.5
EXHAUST CFM	52000	52000
KWH (Measured with ALM 30)	12.80	11.10
PER DAY UNITS/23 HOURS	294.40	255.30
UNITS SAVINGS PER DAY	0	39.10
UNITS SAVINGS PER MONTH		1173
COST SAVING PR MONTH		Rs 5278.50
MOTOR COST		25119.00
PAY BACK PERIOD		4MONTH AND 22 DAYS

MEHALA MACHINES INDIA LIMITED

PROFILE

Mehala Machines India Limited (Motor Division), is a trend setting Organization in the manufacturers for sewing machine industry over two decades now and currently the market leader in this segment.

- Mehala has a number of manufacturing units in and around coimbatore besides a modern factory in China.
- Mehala is the pioneers to produce motors with copper die cast rotors.
- Copper Die Cast Rotor Motors render efficiency values even superior to Eff1 Level.

- Mehala motors are certified for conformity to CE and CSA standards. These motors also confirm to BIS certifications.
- And company has also certified for ISO 9001-2008 for Quality Management Systems.

- Besides Energy Efficient motors, Mehala has ventured into manufacture of Energy Efficient submersible pump sets catering to agriculture using Copper Die Cast Rotors.
- These pump sets surpass even the 5 star norms of the Bureau of Energy Efficiency

MEHALA SUBMERSIBLE PUMP SET OVER ALL EFFICIENCY ACHIEVED Vs SPECIFICATIONS

HP/ STAGE	Head (m) / Q (lpm) DelIVERY. Pipe size (Inch)	Minimum Overall Efficiency as per IS :8034	BEE Overall Efficiency (5 star rating)	Achieved overall Efficiency at MEHALA with CDCR and other combinations
5/8	70 / 180 / 2"	35.36 %	42.43%	50%

SAVINGS BY MEHALA EE SUB PUMP SETS WITH CDCR MOTOR

MEHALA EFFICIENCY Vs BEE 5 STAR EFFICIENCY

5 HP 8 STAGE SUBMERSIBLE PUMP SETS 70 m / 180 lpm

<i>PARAMETERS</i>	OVERALL EFFICIENCY FOR BEE 5 STAR 42.43%	OVERALL EFFICIENCY MEHALA 50%
CONSUMPTION (INPUT IN WATTS)	5538	4700 Watts
REDUCTION IN INPUT WATTS		838 Watts
TOTAL SAVINGS FOR 2400 HRS/YR		2011.85 kWhr
SAVINGS @ RS.4.50 / UNIT		Rs.9053.35
FOR PURCHASE APP. 9 Lakhs pump sets / Yr TOTAL SAVINGS / YR		Rs.814.80 Cr.
	SAVINGS	Rs. 814.80 Cr.

Some of Repute clients of our EE Cu-Die Cast Motors

Machine Tools OEM

Reciprocating & Screw Compressor OEM

Crane & Hoist OEM

Air Humidification plant OEM

Industrial Pumps OEM

Stone Crusher Machines OEM

Textile Machines OEM

Spinning Compact Systems OEM

And

More than 10,000 Power looms users

Etc..

THANK YOU

**PLEASE LOOK INTO THE ANNUALIZED ENERGY LOSS
IN YOUR RUNNING MOTOR
TO DECIDE TODAY TO PURCHASE OUR CDR EE MOTOR.**

