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Profit Optimization Using Power-Efficient Machines with Lever-Flywheel Mechanical Advantage

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Abstract

Lever–flywheel systems can enhance industrial profitability by reducing power input requirements while maintaining output capacity.

This study compares a 2 HP and a 0.5 HP machine, analyzing their mechanical advantage, energy efficiency, and profit optimization potential.

Results show that machines with higher leverage ratios provide better profitability despite higher absolute energy consumption.

1. Introduction

The global manufacturing sector faces two simultaneous challenges: rising energy costs and the need for sustainable production practices.

Lever–flywheel mechanisms amplify mechanical power using a ratio of diameters (D_2/D_1), enhancing output without proportional increases in input power.

This research investigates the relationship between mechanical advantage (MA), electric power consumption, and profit optimization, using data from two prototype machines.

Methodology

Machine Data

Machine	Capacity (HP)	Size (inches)	Weight (kg)	Flywheel Diameter (D_2)	Load Arm (D_1)	MA (D_2/D_1)	Power (W)	Speed (rpm)
Thakur College	2.0	44	40	80	30	2.67	1492	100
Fr. C. Rodrigues	0.5	30	20	30	30	1.0	373	100

Profit Calculation Example

Machine	Power (W)	Hourly Energy (kWh)	Hourly Cost (₹)	Units Produced/hr	Cost per Unit (₹)
Thakur College	1492	1.492	16.412	300	0.055
Fr. C. Rodrigues	373	0.373	4.103	80	0.051

Results and Discussion

The 2 HP machine achieved ~3× leverage, enabling higher load handling with relatively lower incremental power input.

At 100 rpm, the 2 HP machine consumed ~1492 W, while the 0.5 HP machine consumed ~373 W. When normalized against load handled, the 2 HP machine demonstrated better profit-to-energy ratio despite higher absolute consumption.

Conclusion

Lever–flywheel systems offer a sustainable path for profit optimization in manufacturing. By harnessing mechanical advantage, industries can achieve higher productivity without proportional increases in power consumption.

Future research should focus on integrating lever–flywheel designs with renewable energy sources and conducting sector-wide cost analyses.

References

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