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Design and Optimize Product Cost of Screw Conveyor

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Abstract: *The screw conveyor is a commonly used device in industries for material handling and transportation. The purpose of this project is to design and optimize the product cost of a screw conveyor. The design process involves determining the required specifications of the conveyor, selecting appropriate materials, and optimizing the design to minimize the cost of production.*
1.Select appropriate materials: The materials used for the screw conveyor will be selected based on their properties, such as strength, durability, and resistance to wear and corrosion.
2. Select appropriate materials: The materials used for the screw conveyor will be selected based on their properties, such as strength, durability, and resistance to wear and corrosion.
3.Design the screw conveyor: The screw conveyor will be designed using standard engineering principles, The design will also be optimized to reduce the cost of production.
4.Optimize the design: The design will be optimized using Ansys Software, which will enable us to test different designs and configurations to find the most cost-effective option..

Keywords: Material Selection, Optimizing Screw Conveyor, Manufacturing Process, Cost Analysis, Testing And Validation,, Design Analysis.

I. INTRODUCTION

Screw conveyors are used extensively in various industries such as agriculture, food processing, and mining to transport materials from one point to another. The design of a screw conveyor is critical to ensure that it operates efficiently and meets the required specifications. The cost of a screw conveyor is also an important factor to consider, as it directly impacts the profitability of industrial operations. This paper presents a comprehensive approach to designing and optimizing the cost of screw conveyors..

- Material Properties: The material properties of the bulk material being conveyed are crucial in determining the screw conveyor's design. The properties to be considered include the material's bulk density, particle size, moisture content, and flow characteristics.
- Screw Diameter and Pitch: The screw diameter and pitch are critical in determining the conveyor's performance and efficiency. The diameter and pitch of the screw affect the conveying capacity, power requirements, and the ability to handle different materials
- Motor selection: Choosing an appropriately sized motor that is both energy-efficient and cost-effective.
- Screw Speed: The screw speed is another important parameter that affects the conveyor's performance. The speed of the screw is determined by the material properties, screw diameter, and pitch.
- CAPP: CAPP is a critical part of computer-integrated manufacturing (CIM) systems and is used in many industries, including aerospace, automotive, and electronics. The primary goal of CAPP is to optimize the manufacturing process by creating a plan that is efficient, cost-effective, and minimizes the potential for errors.

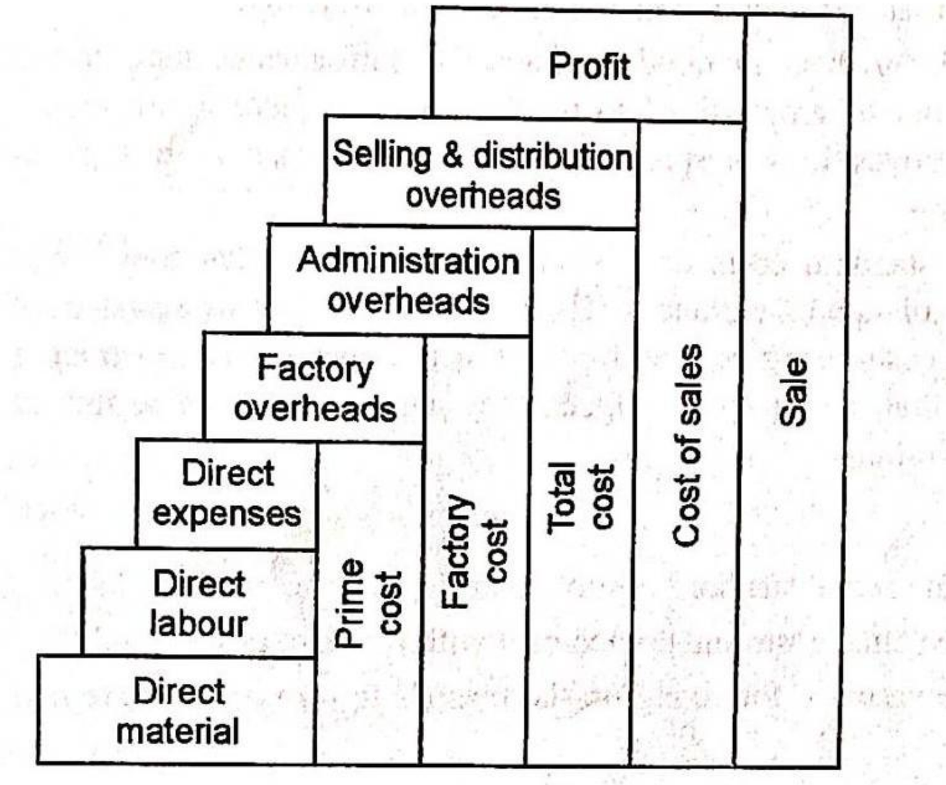
1.1 Problem Statement

The ultimate goal of the project is to produce a screw conveyor that meets the required specifications while minimizing the total cost of production, including materials, labor, and overhead expenses.

1.2 Objectives of Project

- Optimization in cost of product of screw conveyor as per selection of material by analysis of product.
- To get the variation in cost of the product.
- Decreases cost of product by decreasing the thickness of sheet metal.

II. METHODOLOGY



Formulae Sheet Metal Bending

LF= (L1+L2+ L3+ +Ln) + (B1+B2+B3+….+Bn)

L1=L2=L-tan(A/2)×(R+T) BA= A(π/180)×[R+(K×T)]

Welding Data Cost

1. Time required to weld length of plates= lenth of plate / rate of welding
2. Total consumption of oxygen=oxygen consumption per hour × time of welding
3. Total consumption of acytylene =acytylene
4. Consumption per hour×time of welding
5. Effective lenth of filler rod required = lenth of weld/ legth of filler rod requird/m
6. Cost of oxygen consumed= total oxygen consumed × cost of oxygen/m^3
7. Cost of acytylene consumed=total acytylene consumed × cost of acytylene /m^3
8. Cost of filler rod consumed= {(volume of filler rod consumed ×density)/1000}×cost of rod/kg
9. Total material cost of weld = (total cost of oxygen +total cost of acytylene +total cost of filler rod)
10. Labour cost = time of welding × labour hour rate × no. Of pieces.
11. Overhead charges= percentages/ labour cost

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Model cost

1. Actual welding speed = welding speed × operator factor
2. Cost of labour per meter of weld = cost of labour /hr /actual welding speed
3. Power consumption= [(voltage×current)/1000]× machining efficiency ×welding speed
4. Cost of power per meter of weld =power consumption ×cost of power per Kilo-watt/hr (kwh)
5. Cost of electrode per meter of weld= weight of electrode /m × cost of electrode

Machining cost

1. Raw material cost = [area × thickness × density × quantity] / 10^6
2. **Scrap weight =**
3. Process cost = scrap weight ×scrap cost
4. Raw material cost = material cost × raw material weight
5. Net cost =raw material cost **-** scrap cost
6. Machining cost= 15 % of raw material cost
7. Labour cost = 20% of raw material cost
8. Final cost = net cost + machining cost + labour cost

Process cost

1. Prime cost = material cost + labour cost + direct expenses
2. Factory cost = prime cost + administrative overhead (office overhead charges)
3. Selling cost = factory cost + selling overhead charges
4. Profit = 10% of selling cost
5. Final cost = profit + selling cost

III. CALCULATION

COSTING SHEET

PART NO	no pieces	MACHINING PROC	PART IMG	MACHING COST						WEDLING COST				FINAL COST
PART NO 1		LASER CUTTING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG	reqr.time f	Oxgn. consume	actylne consume	cost of filler rod	labour cost	
		PUNCHIMG		7.8		4.8	0.35	4.45					201.6	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actylne	total mtrial cost	machinery cos	
				10	61544	1008	6.36	1001.64					151.2	1354.44
PART NO 2	2	PRESSING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG	reqr.time f	Oxgn. consume	actylne consume	cost of filler rod	labour cost	
		BENDING		7.8		1864	0.19	1863.81					784.47	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actylne	total material cost	machinery cos	
				4	467.07	3922.35	3.57	3918.78					588.3525	5291.6025
PART NO 3		PRESSING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG	reqr.time f	Oxgn. consume	actylne consume	cost of filler rod	labour cost	
		DRILLING		7.8		11.02	0.13	10.89					462.84	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actylne	total material cost	machinery cos	
				20	70650	2314.2	2.34	2311.86					347.13	3121.83
PART NO 4		PRESSING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG	reqr.time f	Oxgn. consume	actylne consume	cost of filler rod	labour cost	
		BENDING		7.8		16.55	9.7	6.85					695.1	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actylne	total material cost	machinery cos	
				5	1122.68	3475.5	174.6	3300.9					521.325	4517.325

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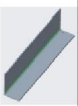
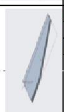
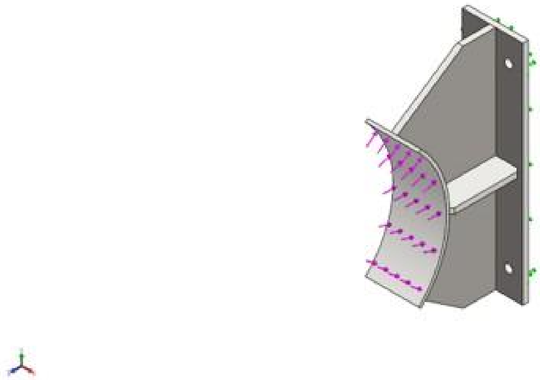
PART NO 5		PRESSING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
		BENDING		7.8		19.68	10.31	9.37		2015.61	2015.6	33397.36	826.56	
		DRILLING		THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				3	59.03*10^	4132.8	185.58	3947.22	1832.38	30234.15	120936.6	184568.11	619.92	189961.81
PART NO 6	2	PRESSING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
		BENDING		7.8		44.07	0.76	43.31					1850.94	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				4	547.98	9254.7	13.68	9241.02					1388.205	12480.165
PART NO 7		PRESSING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
				7.8		13.95		13.95					585.952	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				10	4867	2929.76		2929.76					439.464	3955.176
PART NO 8		PRESSING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
				7.8		4.68		4.68					196.858	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				5	171.69	984.29		984.29					147.6435	1328.7915

PART NO 9		LEASER CUTTING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
		DRILLING		7.8		0.81	0.076	0.734					0	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost of o2	cost of actyline	total material cost	machinery cos	
				4	25600	170.1	1.368	168.732					25.515	194.247
PART NO 10		BENDING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
		DRILLING		7.8		0.5	0.014	0.486					21	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				3	67.63	105	0.25	104.75					15.75	141.5
PART NO 11		BENDING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
				7.8		0.7		0.7					29.446	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost of o2	cost of actyline	total material cost	machinery cos	
				3	93.63	147.23		147.23					22.0845	198.7605
PART NO 12		PRESSING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
				7.8		0.00474		0.00474		1.57	1.562	7.008	0.198	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				3	202.58	0.99		0.99	1.42	23.55	93.72	117.27	0.1485	118.6065
PART NO 13		LEASER CUTTING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
		DRILLING		7.8		3.78	2.02	1.76					158.76	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost of o2	cost of actyline	total material cost	machinery cos	
				10	156*10^3	793.8	36.36	757.44					119.07	1035.27
PART NO 14		PRESSING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
				7.8		0.46	0.09	0.37					19.32	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				8	7425	96.6	1.62	94.98					14.49	128.79
PART NO 15		TURNING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
		DRILLING		7.8		1.53	0.4	1.13					64.26	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				40	1256	321.3	2.52	318.78					48.195	431.235
PART NO 16		LEASER CUTTING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
		DRILLING		7.8		9.89	1.07	8.82					415.38	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				10	126869	2076.9	1926	150.9					311.535	877.815
PART NO 17		TURNING ON		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
		CUTTING		7.8		40.08		40.08					1683.36	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				76	4876997	8416.8		8416.8					1262.52	11362.68
PART NO 18		TURNING		DENSITY	AREA	RM WGT(KG)	SCRAP WGT(KG)	NET WGT(KG)	reqr.time f	Oxgn. consume	actyline consume	cost of filler rod	labour cost	
				7.8		8.27		8.27					347.34	
				THICKNESS		RM COST(RS)	SCRAP COST(RS)	NET COST(RS)		cost oF o2	cost of actyline	total material cost	machinery cos	
				65	3215.36	1736.7		1736.7					260.505	2344.545

IV. ANALYSIS

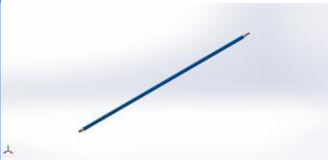
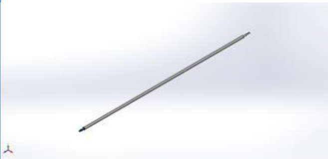
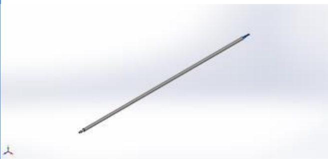


Model name: Apoyo1
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Boss-Extrude1 	Solid Body	Mass:2.18975 kg Volume:0.000280737 m^3 Density:7800 kg/m^3 Weight:21.4595 N	D:\project\project\conyeyor\screw conveyor\screw-conveyor-10-x-10-5-1.snapshot.3\p3.sldprt
Boss-Extrude1 	Solid Body	Mass:0.214001 kg Volume:2.7436e-05 m^3 Density:7800 kg/m^3 Weight:2.09721 N	D:\project\project\conyeyor\screw conveyor\screw-conveyor-10-x-10-5-1.snapshot.3\p31.sldprt
Imported1 	Solid Body	Mass:0.559275 kg Volume:7.17019e-05 m^3 Density:7800 kg/m^3 Weight:5.4809 N	D:\project\project\conyeyor\screw conveyor\screw-conveyor-10-x-10-5-1.snapshot.3\p4.sldprt
Boss-Extrude1 	Solid Body	Mass:1.66905 kg Volume:0.000213981 m^3 Density:7800 kg/m^3 Weight:16.3567 N	D:\project\project\conyeyor\screw conveyor\screw-conveyor-10-x-10-5-1.snapshot.3\p5.sldpr

Model name: SCREW Current Configuration: Default

Solid Bodies			
Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Cut-Extrude2 	Solid Body	Mass:65.8606 kg Volume:0.00844366 m^3 Density:7800 kg/m^3 Weight:645.433 N	D:\project\project\conyeyor\screw conveyor\twin-screw-conveyor-vip\TwinScrew-1\10001203.SLDPRT
M12 Tapped Hole1 	Solid Body	Mass:5.54651 kg Volume:0.000711091 m^3 Density:7800 kg/m^3 Weight:54.3558 N	D:\project\project\conyeyor\screw conveyor\twin-screw-conveyor-vip\TwinScrew-1\10001211.SLDPRT
M12 Tapped Hole1 	Solid Body	Mass:5.98487 kg Volume:0.000767291 m^3 Density:7800 kg/m^3 Weight:58.6517 N	D:\project\project\conyeyor\screw conveyor\twin-screw-conveyor-vip\TwinScrew-1\10001218.SLDPRT

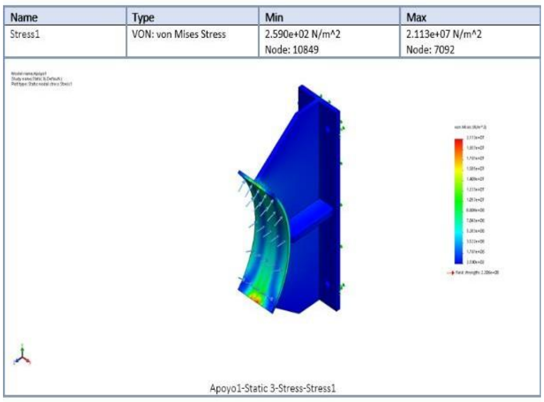


Fig analysis of saddle support

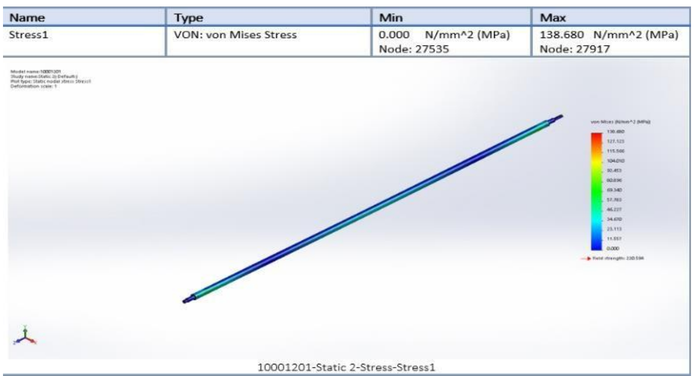


Fig. Analysis of screw

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V. RESULT

Optimization in cost of saddle support

OPTIMIZATION IN COST

843			Case 1			Case 2			Case 3			Case 4		
Material	Plain Carbon Steel		Material	AISI 1020		Material	AISI 1020		Material	AISI 1020		Material	AISI 1020	
Assembly Weight	16.08	Kg	Assembly Weig	15.68	Kg	Assembly Weight	8.58	Kg	Assembly	8.58	Kg	Assembly	4.29	Kg
Plate Thickness	16	mm	Plate Thickness	16	mm	Plate Thickness	8	mm	Plate Thic	6.43	mm	Plate Thic	6.43	mm
Material Cost / Kg	190	INR/KG	Material Cost /	58	INR/KG	Material Cost / Kg	58	INR/KG	Material (	58	INR/KG	Material (	58	INR/KG
Cost	3055.2		Cost	909.44		Cost	497.64		Cost	497.64		Cost	248.82	
Qty	2		Qty	2		Qty	2		Qty	2		Qty	2	
Total Cost (Mater	6110.4		Total Cost (Mat	1818.88		Total Cost (Material Cost)	995.28		Total Cost	995.28		Total Cost	497.64	
Assembly Weight	680	Kg	Assembly Weig	680	Kg	Assembly Weight	680	Kg	Assembly	680	Kg	Assembly	680	Kg
Material Transpo	163	Kg	Material Trans	163	Kg	Material Transportation Weig	163	Kg	Material T	163	Kg	Material T	163	Kg
Total Weight	843	Kg	Total Weight	843	Kg	Total Weight	843	Kg	Total Wei	843	Kg	Total Wei	843	Kg
FEA Results			FEA Results			FEA Results			FEA Results					
Stress	Deformation	FOS	Stress	Deformation	FOS	Stress	eformatio	FOS	Stress	eformatio	FOS	Stress	eformatio	FOS
9.125 MPA	0.015mm	24	9.1116 MPA	0.016mm	39	19.819 MPA	0.036 mm	18	6.515 MP	0.048 mm	13	9.829 MP	0.074 mm	8.8

Cost Reduction	**5612**

Variation in cost of screw

Initial						
Material	**Stress**	**Deflection**	**FOS**	**Weight**	**Cost**	**Total Cost**
ASTM A36	21.89 MPA	0.78 MM	11	127.58	100	12758

Final						
Material	**Stress**	**Deflection**	**FOS**	**Weight**	**Cost**	**Total Cost**
AISI 1090	22.053 MPA	0.7 MM	7.2	128	55	7040

Cost Reduction	5718

PROCESSING COST	
TOTAL MATERIAL NET COST	39532.772
TOTAL LABOUR COST	8806.224
DIRECT EXPENSES	1000
PRIME COST	49338.996
ADMINISTRATION OVERHHEAD	9000
FACTORY COST	58338.996
SELLLING OVERHEAD CHARGE	20000
SELLING COST	78338.996
PROFIT	7833.8996
FINAL MARKET COST	**86172.8956**

Final cost of screw conveyor= initial cost of screw conveyor- total reduced cost
=86172.8956-11330
=74842.8956 RS

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VI. CONCLUSION

In conclusion, the design and optimization of the cost of a screw conveyor are essential for the efficient and cost-effective transportation of materials. The design of a screw conveyor depends on various parameters such as the type of material being transported, the distance it needs to be transported, and the flow rate required. The cost of a screw conveyor is dependent on several factors such as the cost of materials used, the manufacturing cost, and the operating cost. By optimizing these factors, it is possible to design a screw conveyor that is both efficient and cost-effective

VII. ACKNOWLEDGMENT

A screw conveyor is a mechanical device used to transport materials from one point to another by means of a rotating helical screw blade. It is a crucial component in many industrial processes, including food processing, agriculture, mining, and wastewater treatment.

In order to design and optimize the product cost of a screw conveyor, the following steps should be taken:

- Define the requirements: The first step is to define the requirements of the screw conveyor. This includes the type of material to be transported, the flow rate, the distance to be covered, and any other specifications.
- Determine the size and capacity: Based on the requirements, the size and capacity of the screw conveyor can be determined. This includes the diameter of the screw, the pitch of the helix, the length of the conveyor, and the motor size.
- Material selection: The selection of materials is critical to the cost optimization of the screw conveyor. The materials used should be of high quality, durable, and cost-effective. The choice of materials will also affect the weight of the conveyor, which can impact transportation and installation costs.
- Manufacturing process: The manufacturing process should be optimized to minimize waste and reduce labor costs. This includes using automated machinery and techniques such as laser cutting and CNC machining.
- Testing and validation: The screw conveyor should be tested and validated to ensure that it meets the required specifications and is functioning properly.
- Cost analysis: The final step is to conduct a cost analysis of the screw conveyor. This includes the cost of materials, manufacturing, assembly, and testing. The cost analysis should be used to identify areas where costs can be reduced without compromising the quality or functionality of the product.

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