STUDY ON ELECTRICAL POWER CONSUMPTION STATUS OF JUTE MILL

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ABSTRACT: *Electrical power consumption status of Bally Jute Company Ltd, Bally, Howrah, was studied. It was found that, 93.02 % Electrical power was consumed /day for production area of finished goods and 6.95 % power was consumed in other than production area. It was found that, spinning department is responsible for 37.75 % share of power consumption /day, followed by weaving department having share of power consumption /day was 19.04 %. Other major department of power consumption is Batching [14.29%], Winding [5.75 %], preparing [5.67 %], and Press [3.27 %]. It was observed that 19 watt LED tube light was replaced by conventional tube light which has given power shaving to the unit. There are statistically significant differences between actual unit consumed / M. Ton/day in winter and summer session. Strong positive co relationship exists between total per day production in spinning and weaving department and actual unit consumed / M.Ton /day.*

KEY WORDS: Spinning, weaving, Power, Production, Co relationship, Significant

INTRODUCTION:

Jute industries are found to be energy-intensive compared to other industries. Here a large number of orthodox machineries are running. Less automation of machineries and processing created a burden of industry. A large amount of money is becoming wastage due to power which is given higher conversion cost from raw jute to finished goods. But no extensive research has been done on such industries in the past to reduce the energy cost and the total input cost. This paper highlights some energy consumption status of various department and finding out the major electrical power consumption department. The study gives economic benefit to the Jute mills to find out the necessary measures to reduce electrical power consumption cost, which is now urgent to reduce the manufacturing cost. Jute industry in India is a vital industry. A large number of people are engaged from cultivation of plant to manufacturing of finished goods. Due to low modernization in processing of finished goods electrical power cost is very high in Jute industry. Man power is also shortage in Jute mills due to dusty environment inside the mill and heavy noise from the machines. Due to these reasons workers are not showing interest in working at Jute mills, which compel mill management to deploy more automated machines. The owner of the Mills are now concentrated on Modernization of machineries for manufacturing quality of finished goods. The modernization of machineries and up gradation of technological develop machineries are now given lower electrical power consumption and lower wastage of electrical power.

STUDY AREA:

Bally Jute Company Ltd. Bally, Howrah is a pioneer Jute industry in West Bengal. Nearly 3500 employees are directly related with such industry. Jute Yarn, fabrics, bags, carpets etc. are the major finished products of such industry. A large number of orthodox machineries are running in this unit. As a result high electrical power is consumed each day for conversion of raw Jute to finished goods. The unit has various departments. The power consumption status of various department and respective machineries are the main objectives of this study. The study helps us to identify the high power consumption machineries and necessary corrective measures to reduce it.

RESEARCH OBJECTIVES:

The objectives of the Research study are stated below:

- To study the power consumption status of the entire Mill .
- To identify the major power consumption department of the mill.
- To find out the relationship between day wise total production and total unit consumed /day

RESEARCH METHODOLOGY:

Electrical engineering department of the organization regularly maintain the data sheet of no. of machines running in various department , power consumption of departmental , production of spinning and weaving department , power consumption of other than production areas. We have studied the data sheet from computer generated report. So, the study is based on company's own data of different month. The computer generated report is available on each day. Based on the computer generated report , study is conducted on the data available . Statistical analysis and discussion is taken on the basis of statistical analysis. Regression equation is set up between the day wise total production of spinning and weaving and total unit consumed in production area. Pearson's correlation coefficient is calculated on total spinning weaving production and total unit consumed /day due to production. Positive correlation ship is observed between the two parameters. Data obtained the electrical power consumed in winter and summer seasons are found to be significantly difference. It is found that electrical power consumed in winter seasons are significantly different and lower than summer season.

LITERATURE REVIEW:

The Indian government has already been selected the energy sector in industry as a priority sector & stressed the need of efficient use of energy in industry. Most of the state governments in India have made energy audits mandatory for large scale energy consuming industries. So in industrial sectors the energy saving practices is gaining importance of the realization that „energy saved is energy produced & that too at economical cost". The author shares the experiences regarding some of the energy saving measures of jute mill situated in West Bengal. The effect of such measures was realized through reduction of cost in respect of energy [1].

This study investigates the electricity consumption and emissions of jute product manufacture stages at Rajshahi Jute mill in Bangladesh. Electricity consumption and emissions at various production stages were estimated. The energy inefficient stages and potential improvement solutions were also investigated to further improve the product manufacture to be an energy efficient way. The result showed that 50% electricity consumption observed in spinning process. The electricity required per day is 28,604 kWh and per ton jute product is 1,345 kWh. Two possible alternative improvement options namely weaving and winding process were investigated. The study showed that daily 3,076 kWh electricity consumptions could be possible to reduce which is 11% of daily total electricity consumption in the Jute mill. The environmental analysis showed that about 1.92 ton CO2 emissions per day can be reduced using the alternative improvement options. The analysis of economic benefit showed that the operating cost could be possible to reduced BDT 27,684 per day and BDT 1,318 per ton production of Jute goods. Hence, government can take suggestions from this study to reduce the energy consumption of Jute industry in Bangladesh [2]

Energy efficiency improvement and energy saving are major industrial concerns now-a-days. This paper mainly aims at focusing key issues for reducing energy wastage and subsequent reduction of excessive energy consumption due to inefficient machinery and unplanned electrical system. In order to improve the energy consumption pattern, particularly jute processing industry of Bangladesh is considered as case study; several energy saving scopes and way of improvement have been identified. The objective is to addresses utilization strategy through mathematical analysis to maximize machine efficiency leads to greater production, financial profit by reduction of energy bill as well as trapping carbon emission. In addition, to attain the target of improving energy efficiency of Bangladesh Government's Sustainable Development Goal (SDG), this strategy can contribute by decarbonizing industrial operation and supply chains thorough improved energy efficiency. Also tend to reduce the carbon footprint of jute products, services and processes. This leads to setting ambitious emissions reductions targets in line with development of green industry; also scaling up potential investment scope as Clean Development Mechanism (CDM) projects in the development of innovative low-carbon products and service [3].

RESULTS AND DISCUSSION:

Table 1 : Power Consumption in various Department of Jute Mill

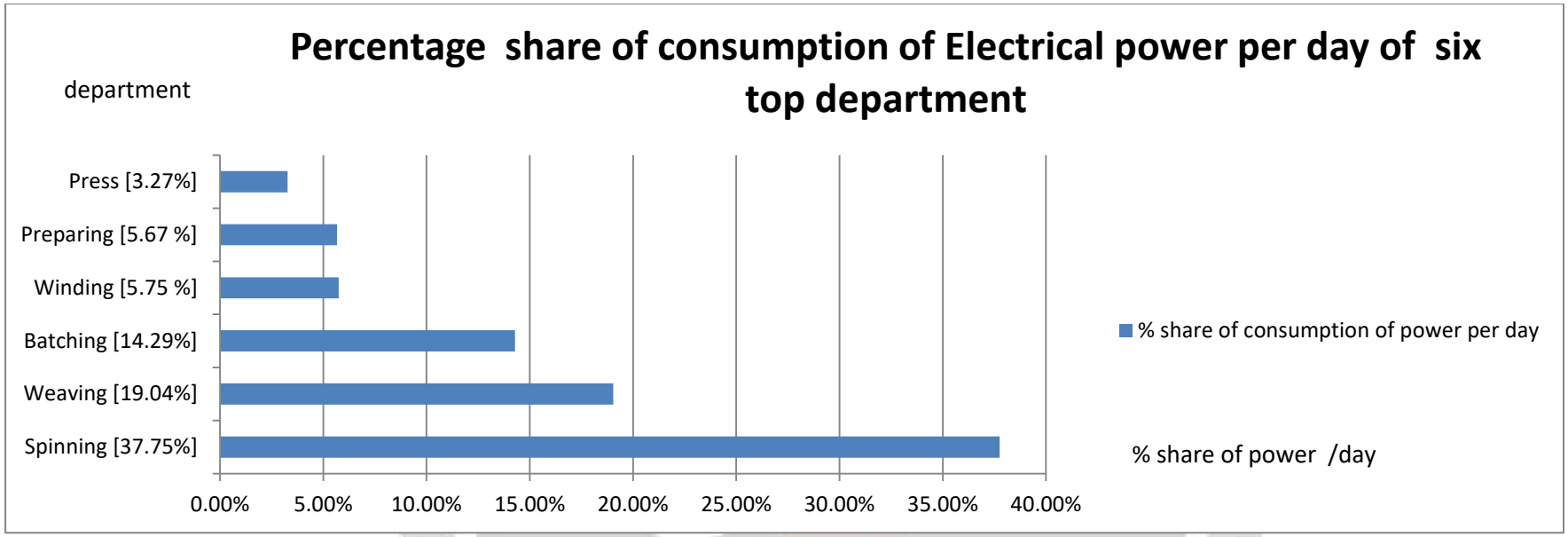
Department	Date														
	1.3.20			2.3.20			3.3.20			4.3.20			5.3.20		
	Consumption /8 hrs./mcs	Total Consumption of unit	Total No of Machines	Consumption /8 hrs./mcs	Total Consumption of unit	Total No of Machines	Consumption /8 hrs./mcs	Total Consumption of unit	Total No of Machines	Consumption /8 hrs./mcs	Total Consumption of unit	Total No of Machines	Consumption /8 hrs./mcs	Total Consumption of unit	Total No of Machines
Batching	899.4	8050.8	196.5	899.4	8051.05	244	899.4	7774.25	188.5	899.4	7553.2	186.5	899.4	7861.35	191.5
PREPAIRING	99.5	3101	159	99.5	3181	161	99.5	3085	158	99.5	3059	157	99.5	3120	160
Twisting Frame (Go down no. 10)	275	550	2	275	275	1				275	550	2	275	550	2
WINDING	288.5	2937	206	288.5	3131.5	209	288.5	2822	177	288.5	3030	199	288.5	3162	211
BEAMING	403	1340	35	403	1253	34	403	1229	34	403	1250	34	403	1293	35
WEAVING	1638.9	9875.3	2024	1638.9	10788	2097	1638.9	10343.2	2080	1638.9	10259.8	2104	1638.9	10473.1	2150
FINISHING	103.25	439	49	103.25	538	59	103.25	325	42	103.25	470	56	103.25	536	58
Press	225	1800	8	225	1800	8	225	1575	7	225	1350	6	225	1800	8
WORK SHOP	318.5	476	14	318.5	476	14	318.5	476	14	318.5	476	14	318.5	476	14
Godown No	31.25	57.25	16	31.25	57.25	16	31.25	57.25	16	31.25	54.75	15	31.25	57.25	16

10															
Godown No 15	**35.75**	**54.5**	**13**	**35.75**	**54.5**	**13**	**35.75**	**45**	**9**	**35.75**	**54.5**	**13**	**35.75**	**54.5**	**13**
total		**27142**			**27881**			**26382**			**26683**			**27704**	
Spinning	**629**	**19572.1**	**283**	**629**	**20156.9**	**291**	**629**	**17991.1**	**262**	**629**	**19501.55**	**280**	**629**	**20756.15**	**299**
Godown No 3	**31.25**	**116.75**	**28**	**31.25**	**114.25**	**27**	**31.25**	**116.75**	**28**	**31.25**	**117**	**28**	**31.25**	**114.25**	**27**
Grant Total including other sources		**52940**			**54441**			**50745**			**52661**			**54982**	

Source: Electrical power consumption report book of the Mill

From table 1 and Figure 1, it is found that top six department of power consumption /day are Spinning having share of consumption per day is 37.75 % is the top electrical power consumption in the mill BJCL. Second highest power consumption area is Weaving, having share of consumption of power 19.04 %/day .Third highest power consumption area is Batching , having share of power consumption is 14.29 %. Fourth highest power consumption area of the unit BJCL is winding; having share of power consumption is 5.75 %. Fifth highest department is Preparing, having share of power consumption /day is 5.67 % . Sixth highest power consumption department is Press , having share of consumption /day is 3.27 %.

Figure 1 : Share of electrical Power Consumption at various department of BJCL in first week of March 2020



We know that the conventional type tube light sets are draw more current then LED tube light set. So we are studying on this matter and replace conventional set by LED tube light set. The tube light sets are taken 0.40 kW per set. Approx. 1500 pcs. Tube light sets are installed in mill area.

Total consumption in one hour = 0.40 X 1500 = 600 kWh

For one day = 600 X 12 = 7200 kWh (considering 12 hrs. running)

For one month = 7200 X 30 = 216000 Units

After implementation of 18 watt LED tube light,

Total consumption in one hour = 0.18 X 1500 = 270 kWh

For one day = 270 X 12 = 3240 kWh (considering 12 hrs. running)

For one month = 3240 X 30 = 97200 Units

Total saving per month = 216000-97200 = 118800 unit

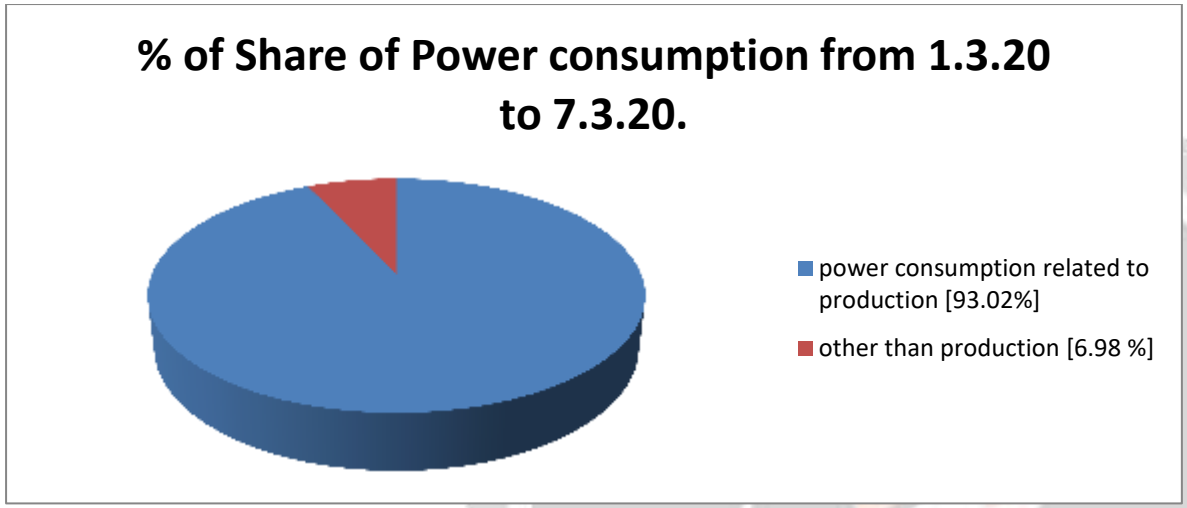
Table 2 : Electrical Power Consumed at Various areas on different days

Areas	**1.3.20**	**2.3.20**	**3.3.20**	**4.3.20**	**5.3.20**	**6.3.20**	**7.3.20**		
	Actual Unit Consumed	**Actual Unit Consumed**	**Actual Unit Consumed**	**Actual Unit Consumed**	**Actual Unit Consumed**	**Actual Unit Consumed**	**Actual Unit Consumed**	**Average Value**	**Remarks [Percentage of total]**
Other than Spinning	24765	25316	24847	25003	25964	26299	25814	25429.71429	
Spinning	18312	18792	17664	19032	19752	19236	20316	19014.85714	
New shed	2640	2640	2520	2880	3120	2880	3240	2845.714286	
Total Production saleable	**45717**	**46748**	**45031**	**46915**	**48836**	**48415**	**49370**	47290.28571	**93.02 %**
Go down no. 3	120	72	97	92	99	113	83	96.57143	
Total water service Pump	1352	1371	1346	1347	1372	1191	1408	1341	
Boiler	426	411	417	393	394	392	388	403	
G+3 Building	45	45	47	47	49	52	53	48.28571	
Worker Line	937	1190	1098	970	807	873	866	963	
Staff Mess	24	24	40	24	23	21	23	25.57143	
Old Canteen	41	41	25	40	40	47	45	39.85714	
Boundry Mill	250	225	250	250	250	250	250	246.4286	
Main office	85	85	85	85	85	85	85	85	
Mill Lighting	245	290	302	267	323	299	349	296.4286	
Total Production	3525	3754	3707	3515	3442	3323	3550	3545.143	**6.98%**
G.Total Production	49242	50502	48738	50430	52278	51738	52920	50835.43	

Source: Electrical power consumption report book of the Mill

Table 2 explained the various areas consumption pattern of electrical power from 1.3.20 to 7.3.20.It is found that other than spinning , spinning and new shed has major consumption .These three areas covered 93.02 % of total per day consumption. Other than spinning and new shed indicates weaving department , both conventional and shuttle loom department.

Figure 2 Percentage share of Electric power consumption from 1.3.20 to 7.3.20



From figure 2 , it is found that power consumption due to production activities were 93.02 % and 6.98 % was due to other than production activities. Other than production activities are different godown, main offices, canteen, staff mess, mill lightening, labour colony etc. So, production activities are consuming major share of power in each day as studied from 7 days data from the 1st week of March 2020.From the 6.98 % share of other than production line, it is found that from figure 2,, water service pump has been consumed 37.8 % , followed by worker colony lightening having share of 27.16 % of total other than production activities. Boiler consumed nearly 11.36 % and Mill lightening consumed 8.36 % of the total other than production activities consumption of the mill.

Figure 3 : Power consumption in other than production details from 1.3.20 to 7.3.20

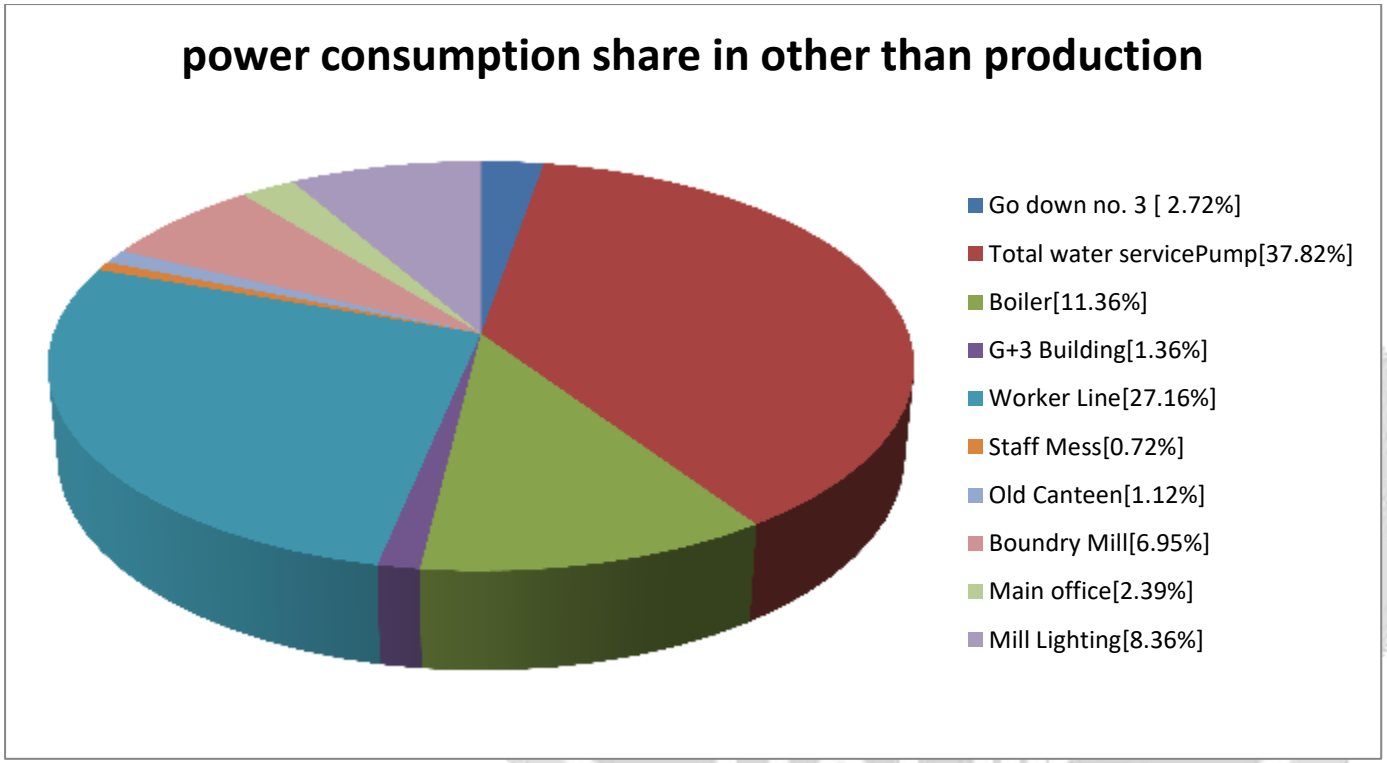


Table3 : Electrical Power Consumed in the different day of December 2019 and March 2019

Sl No.	Date of December 2019	Actual unit /per M.Ton	Total Production in MT	Total unit Consumed	Date of March 2020	Actual unit /per M.Ton	Total Production in MT	Total unit Consumed
1	1.12.19	435.07	187.338	46452	1.3.20	461.20	177.756	49242
2	2.12.19	442.21	180.388	47215	2.3.20	473.00	184.13	50502
3	312.19	429.11	170.748	45816	3.3.20	456.48	181.304	48738
4	4.12.19	447.32	194.484	47760	4.3.20	472.32	185.236	50430

5	5.12.19	459.06	192.888	49014	5.3.20	489.63	193.166	52278
6	6.12.19	447.32	191.344	47760	6.3.20	484.57	197.168	51738
7	7.12.19	445.97	187.86	47616	7.3.20	495.64	199.114	52920
8	8.12.19	427.37	171.782	45630	8.3.20	495.20	189.26	52872
9	9.12.19	441.14	175.192	47100	9.3.20	468.56	165.818	50028
10	10.12.19	435.07	159.27	46452	11.3.20	404.33	151.328	43170
11	11.12.19	444.17	164.626	47424	12.3.20	441.47	174.668	47136
12	12.12.19	455.69	173.894	48654	13.3.20	443.38	174.086	47340
13	13.12.19	453.16	165.774	48384	14.3.20	451.92	178.336	48252
14	14.12.19	460.47	179.666	49164	15.3.20	436.36	180.776	46590
15	15.12.19	452.37	170.648	48300	16.3.20	454.34	180.33	48510
Average		445.0333	177.7268	47516.07		461.8933	180.8317	49316.4
Max		460.47	194.484	49164		495.64	199.114	52920
Min		427.37	159.27	45630		404.33	151.328	43170
SD		10.24	11.06	1093.34		24.96	12.1	2664.73
CV %		2.3	6.22	2.3		5.4	6.69	5.4

Source : Electrical power consumption report book of the Mill

Table 4 : Areas where More than 100 HP Motor are installed and number of Machineries

Sl No	Department	HP Installed	No of Machines installed	Sl No	Department	HP Installed	No of Machines installed	Sl No	Department	HP Installed	No of Machines installed
1	Spreader	184	8	**10**	Macroll Winding	192	50	**18**	Ring spinning	225	9
2	Breaker Card	285	19	**11**	Cop Winding	105	10	**19**	Spinning (A/D Spinning)	216	12
3	Finisher Card	150	15	**12**	**H.T. Motor (no. 3)**	120	1	**20**	Spinning (4.25)(120 Spld)	190	8
4	**HT Motor NO. 2**	120	1	**13**	**H.T.Motor (no. 5),narrow loom**	210	426	**21**	Spinning (4.25)(100 Spld)	810	54
5	2nd drawing	115	23	**14**	Narrow Loom (Individual drive)	118	62	**22**	Spinning (4.75)(96 Spld)	120	8
6	Finisher Drawing	130	26	**15**	S.4.Loom	564	S.4.Loom	**23**	Spinning (4.75)(120 Spld)	215	12
7	Dressing (Indotex)	180	3	**16**	Sprinkler Pump	100	1	**24**	Spinning (5.5) (96 Spld)	205	9

8	**Weaving H.T.Motor (no. 4)narrow loom**	210	135	**17**	Hydrant Pump	100	1	**25**	Cannel Pump	120	3
9	i) N/L (individual Drive)	304	152								

Source : Electrical power consumption report book of the Mill

Table 4,indicates the various department , number of machines installed and HP installed capacity .The table indicates the HP of Electrical power having higher than 100 HP.There are 25 areas where more than 100 HP are installed .Spinning and Weaving areas are the areas where higher number of machines are installed . As a result higher installed capacity of HP .

Table 5 Statistical Analysis

Subject to be tested	T value [two tailed]	P value	Results of significance	Remarks
Actual unit /per M.Ton /dayin December 19 and March 20 has significance Differences=H_0	The t-value is -2.42064	The p-value is .022229	The result is significant at p < .05.	H_0 = rejected . There is significance difference between Actual unit consumed /M Ton /day in Winter and Summer season i.e., in The month of December 19 and March 20
Total unit Consumed/day in the month of December 19 and March 20 has significance difference = H_0	The t-value is -2.42081	The p-value is .02222.	The result is significant at p < .05.	H_0 = rejected . There is significance difference between Total unit consumed /day in Winter and Summer season i.e., in The month of December 19 and March 20

Table 6 : Regression Analysis

Subject to be compaired	1.12.19 to 15.12.19	1.3.20 to 16.3.20	Remarks
[X]=Actual unit /per M.Ton And [Y]=Total	$\hat{y}$ **= 0.30629X + 41.4193** regression equation	the regression equation for Y is: $\hat{y}$ **= 0.33007X + 95.04212** Sum of X = 6928.4	Positive correlation exists between total per day production in spinning and weaving section and actual unit consumed /M.Ton

Production in MT/day	Sum of X = 6675.5 Sum of Y = 2665.902 Mean X = 445.0333 Mean Y = 177.7268 Sum of squares (SSX) = 1467.7635 Sum of products (SP) = 449.5555 Regression Equation = ŷ = bX + a b = SP/SSX = 449.56/1467.76 = 0.30629 a = MY - bMX = 177.73 - (0.31*445.03) = 41.4193 The value of R is 0.2836. Although technically a positive correlation, the relationship between your variables is weak (nb. the nearer the value is to zero, the weaker the relationship). he value of R2, the coefficient of determination, is 0.0804. he P-Value is .305685. The result is not significant at p < .05.	Sum of Y = 3712.476 Mean X = 461.8933 Mean Y = 247.4984 Sum of squares (SSX) = 8719.8929 Sum of products (SP) = 2878.159 Regression Equation = ŷ = bX + a b = SP/SSX = 2878.16/8719.89 = 0.33007 a = MY - bMX = 247.5 - (0.33*461.89) = 95.04212 ŷ = 0.33007X + 95.04212 The value of R is 0.8447. This is a strong positive correlation, which means that high X variable scores go with high Y variable scores (and vice versa). he value of R2, the coefficient of determination, is 0.7135. The P-Value is .000074. The result is significant at p < .05.	/day. Now the relationship is true in both the time frame in the time frame of 1.3.20 to 16.3.20 the R value is 0.8447 which is positive and strong correlation ship exist with value of R^2 is 0.7135. The relationship is statistically significant at 95 % confidence level. Whereas in the time period of 1.12.19 to 15.12.20 two parameters are positively correlated but statistically not significant. Both the cases regression equation can be obtained.
Total unit Consumed=[X] Total Production in MT/day=[Y]	the regression equation for Y is: **ŷ = 0.00287X + 41.46619** Sum of X = 712741 Sum of Y = 2665.902 Mean X = 47516.0667 Mean Y = 177.7268 Sum of squares (SSX) = 16735412.9333 Sum of products (SP) = 47991.7172 Regression Equation = ŷ = bX + a b = SP/SSX = 47991.72/16735412.93 = 0.00287	the regression equation for Y is: **ŷ = 0.00384X - 8.35222** Sum of X = 739746 Sum of Y = 2712.476 Mean X = 49316.4 Mean Y = 180.8317 Sum of squares (SSX) = 99410673.6 Sum of products (SP) = 381351.9336 Regression Equation = ŷ = bX + a b = SP/SSX = 381351.93/99410673.6 = 0.00384 a = MY - bMX = 180.83 - (0*49316.4)	Total production in spinning and weaving areas/day is positively correlated with total unit of electrical power consumed. The value of R correlation coefficient is 0.844 , which indicates strong positive correlation exist between the two parameters. Value of R^2 is 0.7135 with p values indicating the positive relationship is statistically significant at 95 % confidence level. But in the period of 1.12.20 to 15.12.20, thew value of R is 0.28 indicates weak positive correlation ship exist between the two

	a = MY - bMX = 177.73 - (0*47516.07) = 41.46619 ŷ = 0.00287X + 41.46619 The value of R is 0.2835. lthough technically a positive correlation, the relationship between your variables is weak (nb. the nearer the value is to zero, the weaker the relationship). The value of R2, the coefficient of determination, is 0.0804. The P-Value is .305863. The result is not significant at p < .05.	= -8.35222 ŷ = 0.00384X - 8.35222 The value of R is 0.844 This is a strong positive correlation, which means that high X variable scores go with high Y variable scores (and vice versa). The value of R2, the coefficient of determination, is 0.7135. The P-Value is .000074. The result is significant at p < .05.	parameters. Both the time frame regression equation can be obtained.

CONCLUSIONS:

The present study gives a clear idea about the electrical power consumption status of Jute Industry. From the study it is found that, Spinning, Weaving, Batching and Winding are the major department which contributes more than 75 % power consumption /day. Management is now concentrated to reduce the power consumption in such department. Top Management is now installing more S4 and Victor modern weaving machines which consumed less power than conventional shuttle loom. The modern shuttle loom also gives higher productivity and fault free fabric which accepted customers. High variation of power consumption in summer session compare to winter session and less power consumption in winter session indicating that Management should concentrate on summer session for control measures on power consumption .High variation of power consumption pattern in summer seasons indicates, variation in machines running in such time due to absentees of machine operator . This gives variation is productivity in day wise which is not desirable. Regression equation of total spinning weaving production in M. Ton and total electrical unit consumed helps us to identify the unit consumed for desired level of production and corrective measures to reduce the manufacturing cost.

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