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Calculation Energy of Efficiency New Ginning Machine

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Abstract

Having studied the schedule of influence and change of static loading depending on angular an arrangement saw cylinders we have defined the general spent electric energy on the single-chamber two-cylinder gin, by performing of the calculation the energy consumption per one saw with respect to the angular arrangement of the saw cylinder. Also, provide energy audits gin, were performed at Uzbekistan Namangan region cotton gins in ten manufactures.

Keywords

Saw Cylinder, Performed Calculation, Corner, Loading Distributions, Wear Resistance, Energy Efficiency

1. Introduction

According to the World Bank, Uzbekistan's economy is one of the most energy-intensive in the world. For example, the energy intensity of the country's GDP is 35% higher than in neighboring Kazakhstan and three times that of Germany. The industry sector, which often uses outdated technologies in its production processes, accounts for 40% of all energy consumed in the country. The Uzbek government aims to reduce the energy intensity of the economy by about 50% by 2030. To this end, state programmes have been initiated to modernize key energy-intensive sectors. Uzbekistan loses up to $2 billion annually due to excessive consumption of electricity. According to the analysis of the energy efficiency of enterprises in the national sector, the issue of improving the energy efficiency of enterprises is in the focus of attention of the Ministry of Economy of the Republic of Uzbekistan. The analysis showed that the flow rate increased by 8.2%, but since the 2000s, the energy intensity of enterprises

has been decreasing, mainly in the equivalent of 0.98 to 0.48 tons of oil, which is USD 1000. At the same time, the world average is 0.2 tons of oil equivalent. In general, the annual losses of the state from the ongoing processes amount to 4% of GDP [1].

In Uzbekistan cotton manufacture's is one of the largest consumers of electricity and gas in the world. Given this situation, there is a great need in our Republic for the regeneration of high and current technologies and the increase in energy-intensive technologies. Earlier the ginning process was manual but right now for higher production, manufacturers use an automated machine with higher productivity. The machine is well known as a cotton ginning machine. Cotton Ginning process by which the fibers are separated from the seeds is called ginning. Ginning is one of the most important steps of the spinning process. After collecting seed cotton from the field, cotton moves to nearby gins for separation of lint, seed and any other foreign particles. Simply to define ginning we can say that the process is used to get the cleaned cotton by separating or removing the seeds, dust or any other foreign particles. So that better cotton can be offered for the cotton spinning mills. In an automatic ginning process of cotton, a modern machine is preferable. Once the cotton arrives at the processing plant, sticks and burrs are removed as well as any lingering debris and seeds. The ground seed cotton falls onto a conveyor belt, which leads to the hot box, then the hotbox mixes the seed cotton with hot air, which allows the moisture to evaporate, making the seed cotton easier to clean. Then the cotton is to go through cleaning equipment to remove foreign particles or materials. The cotton is then sent to the air conveyed to gin stands where revolving circular saws pull the lint from the saw teeth by air blasts or by rotating brushes. Then the cotton will compress into 500 pounds weigh contained bales. The production of a typical gin is about 12 bale per hour (here 1 bale = 500 pounds = 226.7 kg) [2].

Our cluster cotton manufacture's is equipped with, mainly DP-130, ZHDD, HDD, 4DP-130, 5DP-130. The practical operation of these Gin's shows that their capacity is much lower than the output specified in the work passport, and that the quality of electricity and resource consumption is very high. Electricity is one of the top three variable costs for a cotton gin, right next to bagging and ties, and labor. There are two main aspects to the electricity costs paid by a given cotton gin. The first is the energy price, and the second is the quantity of energy used by a cotton gin. Energy efficiency of cotton gins has improved over the years. Fifteen years ago in Namangan, our gins used an average of about 78 kWh to gin of cotton. Today that number is more like 74 kWh. At the same time, gins in Namangan can use anywhere from 48 to 78 kWh to gin of cotton, based on survey results. This is a lot of variability, and while some of this is due to the cotton condition, or weather conditions, a lot of it is due to the efficiency of the gin. Gins across the Uzbekistan are currently being asked to return a cost survey. A portion of this survey looks at energy usage and energy costs. The other half of this equation relates to the cost of electricity. Electricity production is all about reliability and cost. A good mix of generation sources is very important. Despite

popular talk, coal is a major source of electrical energy, as is natural gas. Balancing the energy needs of the Uzbekistan will continue to be a major issue, from a reliability standpoint, and from a production standpoint. Government associations are actively watching these issues. In the meantime, we can all do your part by keeping your gins as energy efficient as possible. Between these two efforts, we can keep our energy costs to a minimum [3].

At the cotton ginning plants of the republic as well as other countries where cotton is processed and fiber is produced using gins with one saw barrel. During the processing of raw cotton, saw tooth cylinders undergo a constant dynamic load, resulting in deformation, which causes bending deformation and they negatively affect the technological process and the overall design of gin. Also these efforts, to increasing of energy costs. To ensure energy efficiency and the uninterrupted operation of sawed gin, it is necessary to reduce the dynamic load on the saw cylinder by preserving the qualitative and quantitative characteristics of cotton fiber [4] [5].

To increase productivity, energy efficiency and maintain the quality of the fiber, as well as the wear resistance of the saw cylinder, we simulated gin that meets all these parameters [6]. For stable operation of the saw cylinder, the optimum number of saw blades was 90 pcs. The use of gins with the number of 90 pieces of saw blades reduces productivity twice [7] [8] [9].

2. Materials and Methods

We modeled a single-chamber double cylinder with 90 saws per cylinder, total 180 saws shown in Figure 1, which meets all these parameters. Using the static calculation method, we determine the reaction force for each saw cylinder, taking into account the angular position of the saw cylinder relative to the horizontal axis [8].

Figure 1. Single-chamber two-cylinder gin.

$$\sum Ma = 0; \quad R_B = Px = P \cdot \cos\varphi = P \cdot \cos(90 - \alpha) = P \cdot \sin\alpha \qquad (1)$$

$$\sum Mb = 0; \quad R_A = Px = P \cdot \sin\varphi = P \cdot \sin(90 - \alpha) = P \cdot \cos\alpha \qquad (2)$$

Having studied the graph of the influence and changes in the static load as a function of the angular arrangement of the saw cylinders, we came to the conclusion that we can assume optimal angles for modeling a single-chamber two-cylinder saw gin from 45° to 60° degrees relative to the horizontal axis [9].

Accepting 45° degrees will allow increasing the robustness of saws and seeing blades but the process of seed exit from the working chamber becomes more difficult shown in Figure 2. To increase the wear resistance and improve the quality of fiber and seeds, we will take the optimum angle of the 60-degree saw tooth cylinders, results we will reduce the load on the lower saw barrel by 45% and the upper saw cylinder reduces the load by 55% and increases the productivity and robustness of the saw blades [10]. Having determined the ways of increasing the wear resistance, we will consider an increase in energy efficiency by simulating the optimal angular position of the saw cylinders of two-cylinder gin.

3 Results and Discussions

From the following formula, we determine the energy consumption per one saw with respect to the angular arrangement of the saw cylinder.

$$N_1 = \frac{R_a \cdot \omega}{D}; \quad N_2 = \frac{R_b \cdot \omega}{D} \qquad (3)$$

Here

ω—Angular velocity of the saw of the saw cylinder

D—Diameter of saw

Solution following formula, the energy consumption per one saw with respect to the angular arrangement of the saw cylinder upper showed of Table 1. Solution following formula, the energy consumption per one saw with respect to the angular arrangement of the saw cylinder lower showed of Table 2. Determination of the power per saw of the lower saw cylinder (4)
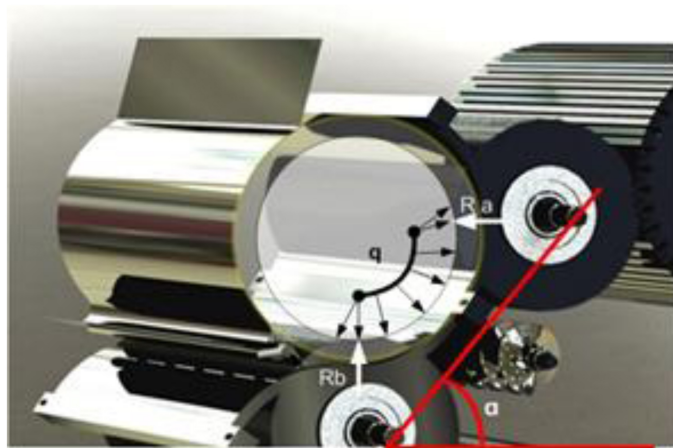
Figure 2. Force distribution in single-chamber two-cylinder gin [7].

Table 1. Determination of the power per saw of the upper saw cylinder.

Indicators	45°	50°	55°	60°	65°	70°	75°	80°
R_a (kg)	3.53	3.21	2.86	2.5	2.11	1.71	1.29	0.86
ω (m/s)	11.66	11.66	11.66	11.66	11.66	11.66	11.66	11.66
D (m)	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
N_1 (vatt)	128.62	116.96	104.21	91.09	76.88	62.3	47	31.33

Table 2. Determination of the power per saw of the lower saw cylinder.

Indicators	45°	50°	55°	60°	65°	70°	75°	80°
R_b (kg)	3.53	3.83	4.09	4.33	4.53	4.69	4.82	4.92
ω (m/s)	11.66	11.66	11.66	11.66	11.66	11.66	11.66	11.66
D (m)	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
N_2 (vatt)	128.6	139.5	149	157.7	165	170.8	175.6	179.2

$$N_{1t} = \frac{N_1 \cdot n}{1000} \tag{4}$$

To determine the consumption of electrical energy on the upper saw cylinder, we use Formula (5)

$$N_{2t} = \frac{N_2 \cdot n}{1000} \tag{5}$$

n—number of saws; 1000-coefficient for determining kwt. To determine the consumption of electrical energy for a low-cut saw cylinder, we use formula.

Solution following formula, the energy consumption per 60 saws with respect to the angular arrangement of the saw cylinder upper showed of Table 3 and Figure 3.

Solution following formula, the energy consumption per 60 saws with respect to the angular arrangement of the saw cylinder lower showed of Table 4 and Figure 3.

Total solution the energy consumption saws with respect to the angular arrangement of the saw cylinder lower and upper showed follow (4 - 5) formula

$$N_t = N_{1t} + N_{2t} \tag{6}$$

$$F_{ish} = \frac{N_t \cdot \mu}{2} \tag{7}$$

From the following Formula (7) showed friction force on the Table 5

$$N_{saw} = F_{ish} \cdot N_t \tag{8}$$

F_{ish}—force expended on friction

Total solution the energy consumption saws N_{saw} with respect to the angular arrangement of the saw cylinder lower and upper showed of Table 5 and Figure 4.
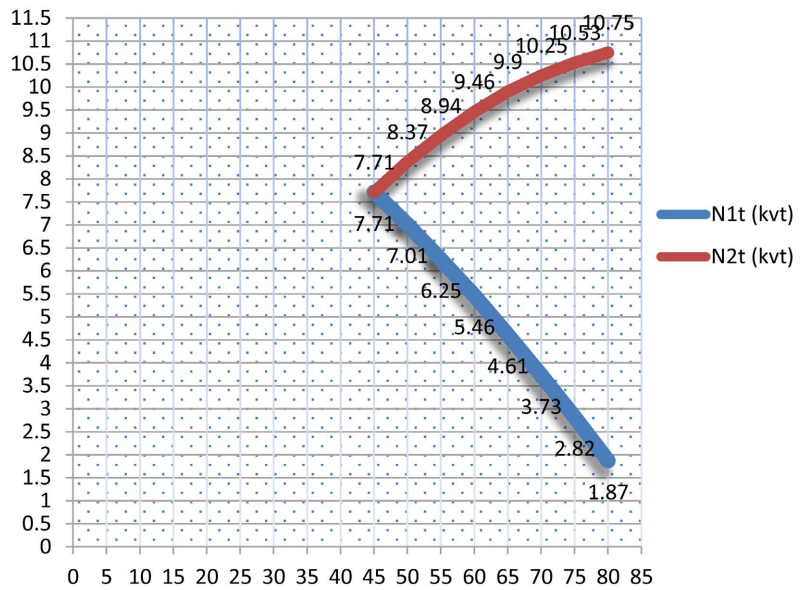
Figure 3. Electricity distribution in single-chamber two-cylinder gin.

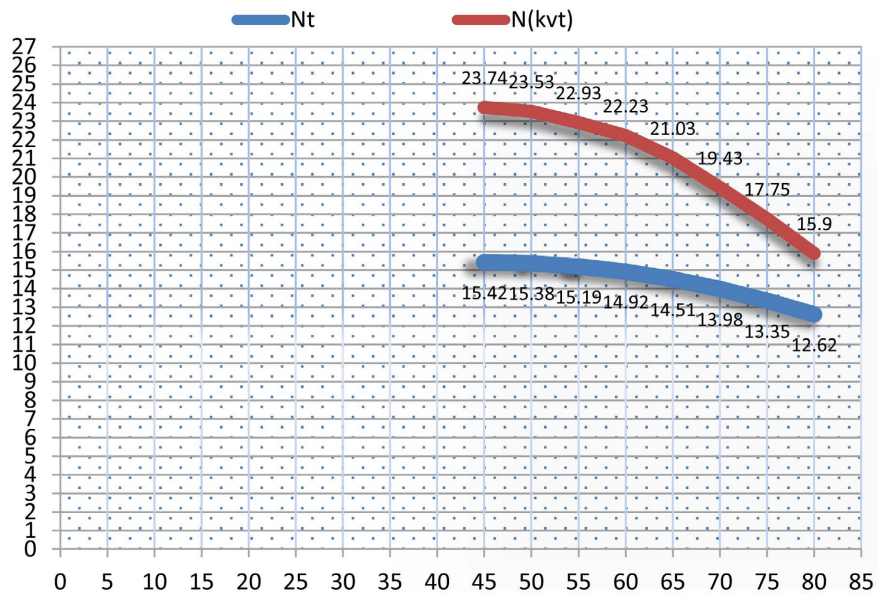**Table 3.** Consumption of electrical energy to the upper saw cylinder.

Indicators	45˚	50˚	55˚	60˚	65˚	70˚	75˚	80˚
R_a (kg)	3.53	3.21	2.86	2.5	2.11	1.71	1.29	0.86
n	60	60	60	60	60	60	60	60
N_1 (vatt)	128.62	116.96	104.21	91.09	76.88	62.3	47	31.33
N_{1t} (kvt)	7.71	7.01	6.25	5.46	4.61	3.73	2.82	1.87

Table 4. Consumption of electrical energy to the lower saw cylinder.

Indicators	45˚	50˚	55˚	60˚	65˚	70˚	75˚	80˚
R_b (kg)	3.53	3.83	4.09	4.33	4.53	4.69	4.82	4.92
n	60	60	60	60	60	60	60	60
N_2 (vatt)	128.62	139.5	149	157.7	165	170.89	175.62	179.27
N_{2t} (kvt)	7.71	8.37	8.94	9.46	9.9	10.25	10.53	10.75

Table 5. Electricity distribution taking into account friction.

Indicators	45˚	50˚	55˚	60˚	65˚	70˚	75˚	80˚
N_{1t} (kwt)	7.71	7.01	6.25	5.46	4.61	3.73	2.82	1.87
N_{2t} (kwt)	7.71	8.37	8.94	9.46	9.9	10.25	10.53	10.75
N_t	15.42	15.38	15.19	14.92	14.51	13.98	13.35	12.62
μ	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
F_{ish}	1.54	1.53	1.51	1.49	1.45	1.39	1.33	1.26
N_{saw} (kwt)	23.74	23.53	22.93	22.23	21.03	19.43	17.75	15.9

Figure 4. Distribution of electrical energy in a single-chamber two-cylinder gin with allowance for friction.

From the following formula, we determine the energy consumption per brushing machine [11] [12].

$$N_b = \frac{P \cdot \omega}{D} \tag{9}$$

$$N_{saw} = F_{ish} \cdot N_t \tag{10}$$

F_{ish}—force expended on friction

Abbreviations From the following formula, we determine the energy consumption per brushing machine [11] [12].

$$N_b = \frac{P \cdot \omega}{D} \tag{11}$$

$$P = K \cdot n \tag{12}$$

P—Total force spent on fiber removal from the saw teeth of the saw cylinder.

K—The force factor for fiber removal by a brush drum from one saw is obtained as a result of measurement $K = 59$ Gramm $= 0.059$ kg.
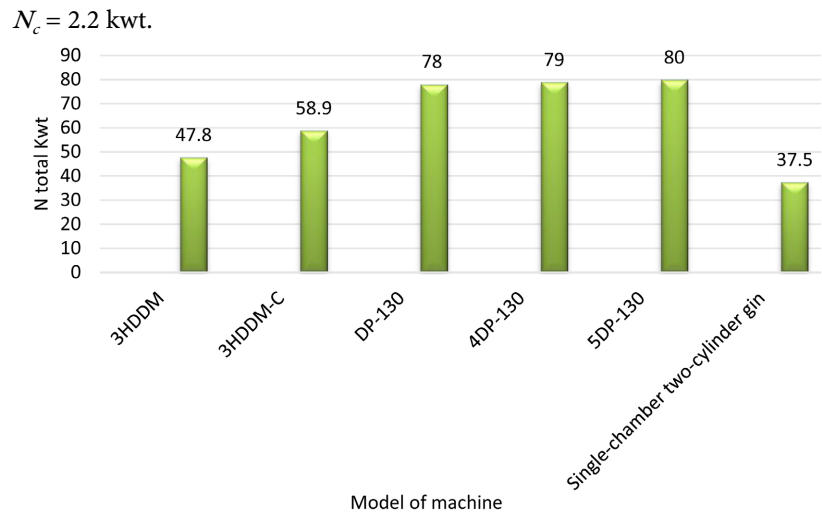
D—Brush diameter.

n—Number of saws.

ω—Angular velocity of the brush drum; $\omega = 25$ m·sec.

$$P = K \cdot n = 0.059 \cdot 25 = 3.54 \text{ kg}$$

Since in our saw gin three brush drums are used the formula will take the following form

$$N_b = \left(\frac{P \cdot \omega}{D}\right) \cdot 3 = \left(\frac{3.54 \times 25}{40}\right) \cdot 3 = 6.63 \text{ kwt}$$

N_c—The energy expended on the cylinder with garniture.

$N_c = 2.2$ kwt.

Figure 5. Electricity power consumption of ginning machine.

Table 6. Analysis of energy efficiency of saw gin's.

Indicators	3HDDM	3HDDM-C	DP-130	4DP-130	5DP-130	Single-chamber two-cylinder gin
N_b	-	-	-	-	-	6.63
N_k	2.2	2.2	2.2	2.2	2.2	2.2
N_v	-	-	-	0.2	0.85	1.5
N_{air}	10	10	10	10	10	-
N_{saw}	45	55	75	75	75	25
N_{total} (kwt)	47.8	58.9	78.5	79.6	80.25	37.53

N_k—the consumed by the power of the pin drum. $N_k = 2.2$ kwt.

N_v—the amount of electric power consumed on the feed roller. $N_v = 1.5$ kwt.

From the following formula, we determine the total consumption of electrical energy for a one-chamber two-cylinder gin (Table 6) [13] [14]

$$N_{total} = N_b + N_k + N_v + N_{saw} + N_c \qquad (13)$$

$$N_{total} = 6.63 + 2.2 + 1.5 + 22.23 + 2.2 = 34.76 \text{ kwt}$$

The Energy audits were performed at 5 Uzbekistan, Namangan region cotton gins in ten manufactures. Gins were selected to represent a broad range of capacity.

A single measure was made of the current drawn by one phase of each motor (multiple readings were recorded for motors with fluctuating loads) [2].

4. Conclusions

Having studied the graph of the influence and variation of the static load, depending on the angular arrangement of the saw cylinders, we determined the total energy consumed per one-chamber double-cylinder gin [15].

Figure 5 shows the energy consumption calculation of existing saw genies. The graphical analysis showed DP-130, 4DP-130 and 5DP-130 have very big energy consumption, also small capacity of fiber.

To determine the optimal energy consumption, we take the optimum angle of the 60-degree saw tooth cylinders to increase the robot capacity of the saw blades. Calculations showed that the total power consumed for electricity consumption in a single-chamber two-cylinder gin was 37.53 kWh. Comparing the obtained data with the actual gins, we came to the conclusion that the use of new single-chamber two-cylinder gins in production allows to increase energy efficiency by 50 percent.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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