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Surface Treatment of Screw and Financial Analysis of Rice Husk Briquetting Machine by Using Different Types of Hardfacing Welding Rods

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Abstract

Nepal still relies heavily on traditional sources of energy to meet its energy demand. Heavy dependence on traditional sources of energy such as fuel wood, animal dung and agro-forest residues causes adverse impact on enviroment and health. Direct briquetting system of the rice husk is chosen for the densification of the loose biomass material. The major problem identified for the rice husk screw press briquetting machine is the life of the screw. Usually the screw wears out within 3-4 hours and become unusual until it repairs. By resurfacing the worn out screw using different welding rods such as Ferrospeed electrodes, Hardcraft 650B, Duroid hardcraft 650R and Superinox-1A we can increase the life of the screw. It is found that Life of the screw is increase upto 12 hours when screw is welded by Duroid hardcraft 650R electrodes. Increment on life of screw is 8 hrs, 8.5hrs and 4 hrs when welded by Hardcraft 650B,Superinox-1A,and ferrospeed respectively. Calculation of net present value, IRR and pay back period shows that plant run by screw which is welded by Duroid hardcraft 650R is more feasible than welded by other welding rods. Duroid handcraft 650R electrode is selected to weld the screw of the briquetting machine among these four electrodes.

Keywords

briquetting – rice husk – screw – wear – welding rods – screw life

1. Introduction

Biomass, in its original form, is difficult to successfully use as a fuel in large-scale applications because it is bulky, wet, and dispersed. Biomass densification represents technologies for converting plant residues into fuel. These technologies are also known as pelleting, briquetting, or agglomeration, which improves the handling characteristics of the materials for transport, storage, etc. Pelleting and briquetting have been applied for many years in several countries. Nepal is predominantly an agricultural country with above 85 percent of its people engaged in growing crops and rearing domestic animals. About 98 percent of energy consumption need of rural Nepal is met from biomass sources derived from the forest, shrub land, and animal waste and crop residues with lots of smoke having direct negative impact on environment and health, especially causing respiratory and eye diseases[1]. Biomass briquetting was introduced in Nepal in the year 1986 through a demonstration program organised by a Japanese private company with the support of the Japanese Embassy [2].

The technology used for the demonstration, was based on the extruder principle and manufactured by Fuji Conveyor. This program fostered a growth in the briquette manufacturing industry. In 1987/88, four extrusion type briquetting machines were imported from Sun Chain Company, Taiwan and established in Simara, Hetauda, Chitwan and Parwanipur. However, by early 1990s most of the briquetting industries, closed down due to various reasons. Presently, Mhaypi Briquette Industry Private Limited, Nawalparasi,Namuna briquette industry,chitwan and Green city Briquette industry private limited,kathmandu is in operation. The major problem identified for the briquetting technology is the life of the screw. Usually the screw wears out within 3-4 hours and become unusable until they are repaired. The wear rate of the screw surface and flights are dependent upon its material of construction. Repairing of the screw causes interruption in the work and also one screw can not be repaired more then 10 times. Therefore, the cost of screw and its repair is one of the barriers to further dissemination of briquetting technology. So in this research work,we try to resurface the screw by hardfacing using different type of electrodes to increase the life of the screw. Screw of the briquette extruder wear due to high compression and friction of the biomass with the screw. Due to the high abrasive characteristics of rice husk,the screw of the extruder used to wear quickly [3]. The wearing of the screw of the extruder usually takes place mainly in the first three flights of the screw near the guiding rod. One method to increase the life of the screw is to use a less abrasive raw material such as sawdust and sugarcane bagasse. Another method is hardfacing of the screw using specialized welding rods to coat the surface of the screw of the extruder [4]. Besides these factors,one important point that affects the screw life is the skill with which welding is done and the screw is prepared. [5]

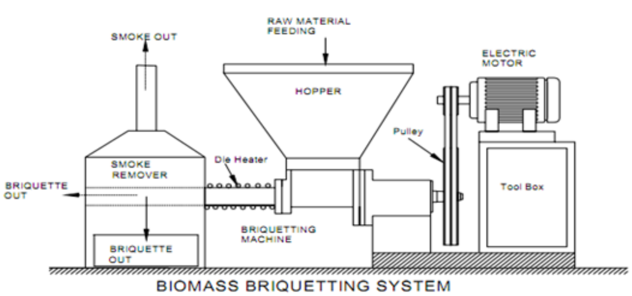

Figure 1: Biomass Briquetting System

1.1 Hardfacing

It is a metalworking process where harder or tougher material is applied to a base metal. It is welded to the base material, and generally takes the form of specialized electrodes for arc welding or filler rod for oxyacetylene and TIG welding. Hardfacing may be applied to a new part during production to increase its wear resistance, or it may be used to restore a worn-down surface. Hardfacing by arc welding is a surfacing operation to extend the service life of industrial components, pre-emptively on new components, or as part of a maintenance program. The result of significant savings in machine down time and production costs has meant that this process has been adopted across many industries such as Steel, Cement, Mining, Petrochemical, Power, Sugar cane and Food.

2. Methodology

The screw of the extruder was prepared using the conventional electric arc welding method. The surfaces of the screws were then prepared with the help of a grinder.Three sets of screws were prepared using the welding rods such as ferrospeed ,Duroid hardcraft650R, Hardcraft 650B and Superinox-1A. The experiment was conducted in the Green City Briquette Industries Pvt. Ltd. Jorpati, Kathmandu. A simple methodology was used to determine the wear of the screw.Change in the height of the threads and change in the thickness of the threads of the screw were measured with the help of a caliper, measuring at exactly the same places before and after briquetting. In all the cases of briquetting the working hours of the screw was noted (the life of the screw) for the evaluation of the performance of the rods. To keep the physical parameters of the raw materials the same. The temperature of the briquetting die (muff) was regulated and noted so as to maintain 300 500C. Other parameters (temperature, pressure, speed, etc.) of the briquetting were assumed to be constant since the same briquetting machine was used throughtout the tests.

3. Results and Discussion

Wear of the screw height and thickness is directly related with position of the thread in the screw. First three screw height are rapid wear than that of the rest of threads. So the only front threads need the regular maintenance.

On the special hardening of the screw by the heat treatment or by using hard material can improve the screw life. Main causes of the wear and tear of the screw are higher silica content in rice husk. From the experiments the percentage of wear in screw has been found in the trend as shown in figures 2 and 3.

3.1 Wear and Tear of screw threads

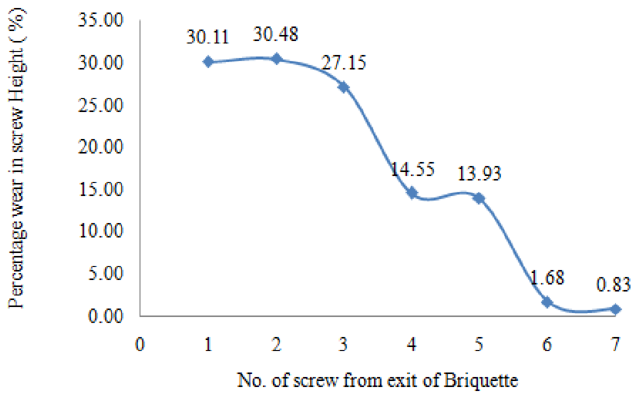

Figure 2: Percentage wear of screw threads in height

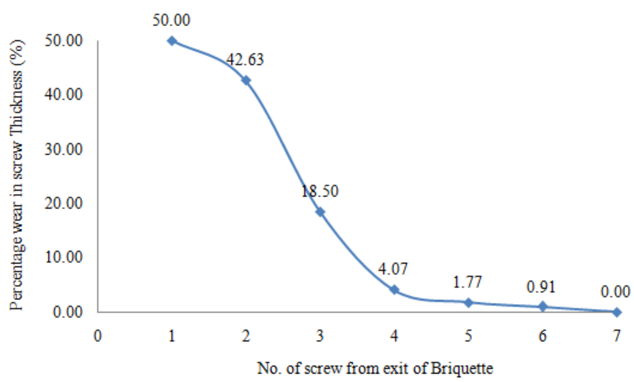

Figure 3: Percentage wear of screw threads in thickness

3.2 Life span of the screw

By welding screw with four different welding rods such as ferrospeed, hardcraft650B, Superinox-1A and duroid hardcraft650R experiments were done. The finding are shown in the graph.

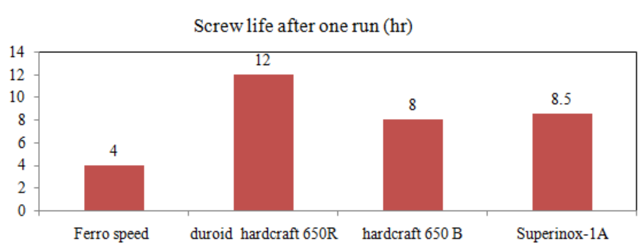

Figure 4: Comparative screw life of differnet screw

Life of the screw is increase heavily when screw is welded by Duroid hardcraft 650R electrodes. After that life the screw is also increase when screw is welded by hardcraft650B and Superinox-1A.But increment on screw life is less when screw is welded by ferrospeed electrode.

3.3 Analysis of life and cost of different screw

From the table of cost analysis it is found that total cost of ferrospeed welding rod is greater than the cost of other welding rods. Cost of Duroid hardcraft 650R is much least comparative to other welding rods.

Table 1: Comparative cost of different screw with different welding rods.

SN	Parameters	Ferro speed	Duroid Hardcraft 650R	Hardcraft 650 B	Superinox1A
1	Initial screw life (hr)	3	3	3	3
2	Screw life after one run (hr)	4	12	8	8.5
3	Screw life after ten run (hr)	40	120	80	85
4	Total screw life (hr)	43	123	83	88
5	Total production per screw (kg)	5160	14760	9960	10560
6	Primary cost of screw	5000	5000	5000	5000
7	Screw repairing cost per run	150	300	200	150
8	Screw repairing cost after 10 run	1500	3000	2000	1500
9	Total cost	6500	8000	7000	6500
10	Screw cost per hour	151.16	65.04	84.34	73.86

3.4 Cost of Rice husk in a year

From the account sheet of the plant, one year cost fluctuation of rice husk is taken and graph is plotted as shown in figure. From the graph it is shown that cost of rice husk is fluctuate according to the seasons of paddy production which shows that it is cheaper on the months of November and December comparatively to other months of off season. Cost of rice husk fluctuated between the ranges of NPR 7 to NPR 13 per kg.

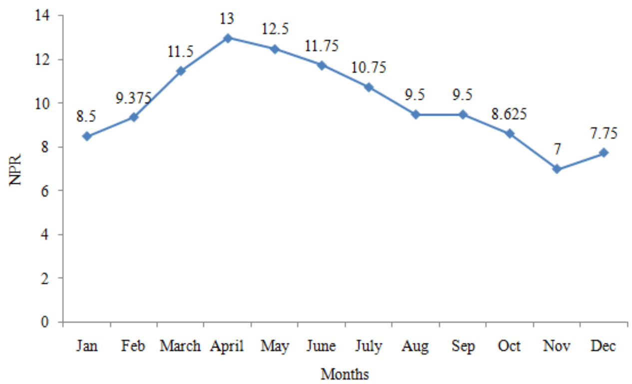

Figure 5: Average price fluctuation of rice husk in a year

4. Financial Analysis

Data used in the financial analysis is shown in tabular form.

Table 2: Cost of machine and machinaries

SN	Particulars	Quantity	Rate (NPR)	Total (NPR)	Remarks
1	Machine and installation	1	1,850,000	1,85,0000	Including building, foundation and machine
2	Screw	1	5,000	5,000	New screw
3	Ferro speed	6	25	150	Retail cost of welding rod
4	Duroid hard craft 650 R	2	150	300	Retail cost of welding rod
5	hardcraft 650 B	2	100	200	Retail cost of welding rod
6	Superinox 1A	3	50	150	Retail cost of welding rod

Table 3: Labour and Maintainence Cost

SN	Particulars	No.	Per month (NPR)	Total (NPR)
1	Welding Technician	1	15,000	15000
2	Unskilled Labour	3	12000	36000

Table 4: Raw Material Cost

SN	Particulars	Unit	Per day	Rate (NPR)	Total cost (NPR)
1	Rise Husk	Kg	744	9.95	7402.8
2	Other expenses	Per month	Lump sum		10000

Table 5: Energy Cost

SN	Particular	Unit	Consumption	Rate (NPR)	Total (NPR)
1	Briquette	Kg/hour	30	30	900
2	Electricity	kWh/Month	1920	12	23040

Table 6: Annual Expenditure cost

SN	Particulars	Per month expenses (NPR)	Total Annual (NPR)
1	Ferro speed	29,023	348,279
2	Duroid hard craft 650R	12,488	149,854
3	Hardcraft 650 B	16,193	194,313
4	Superinox 1A	14,182	170,182
5	Welding Technician	15,000	180,000
6	Unskilled Labour	36,000	432,000
7	Rise Husk	177,667	2,132,006
8	Other Expenses (Admin etc.)	10,000	120,000
9	Annual component of investment		243,226
10	Energy Cost	195,840	2,350,080
11	Maintainance cost		92,500

4.1 Screw per month Expenses (Rs)

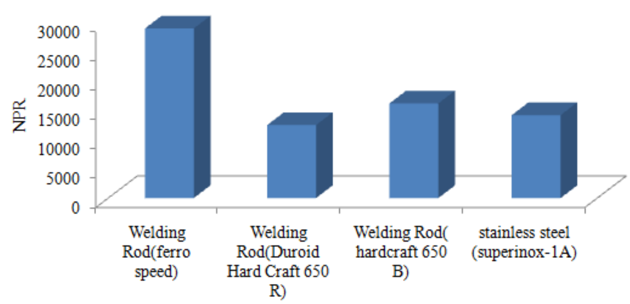

Figure 6: Comparative chart of per month expenses of screw

Per month expenses of screw welded by ferrospeed welding rod is very much greater than Duroid, hardcraft and Superinox-1A. Duroid hardcraft 650R screw is much more cheaper than other welding rods.

4.2 Comparision of Profit of different screw

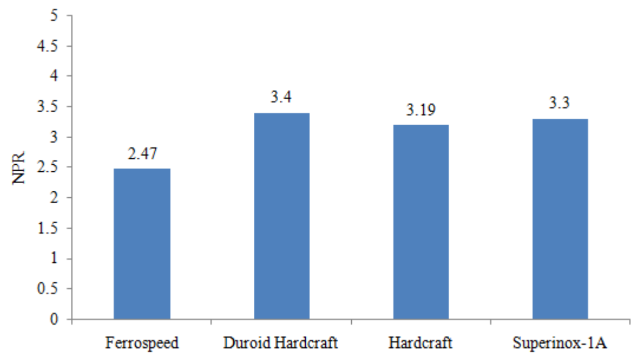

Figure 7: Comparative profit of briquettes produced by different screw

Profit of the briquette produced by welding rod Duroid hardcraft 650R is NPR 3.40 per kg which is highest profit comparative to others welding rods, Profit of the briquette produced by the Superinox-1A is slightly less than profit obtain from the Duroid electrodes which is NPR 3.30 per kg. And least profit is obtain form the Ferrospeed welding rod which is NPR 2.47 per kg.

4.3 IRR comparison

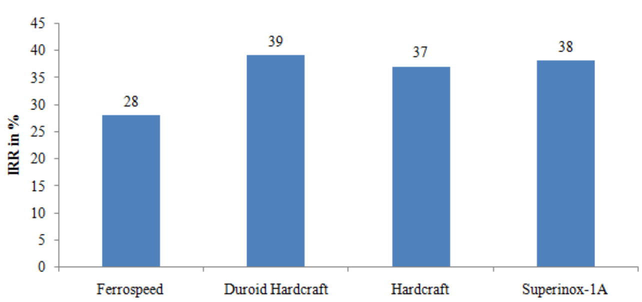

Figure 8: IRR comparison of plant using different screw

Internal rate of return is 39% when we used the Duroid hardcraft welding rod to weld the worn out screw. But IRR is only 28% when we used the Ferrospeed welding rod. IRR is 38% and 37% when we screw is welded by Superinox-1A and Hardcraft welding rods respectively.

4.4 Payback period comparison

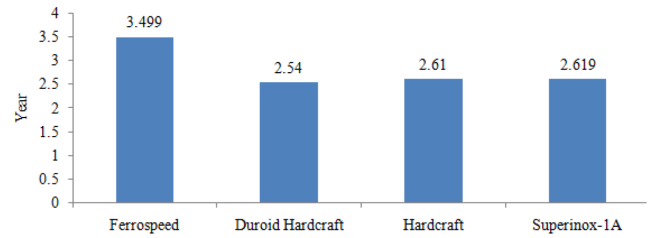

Figure 9: Comparative payback period of plant used by different screw

5. Conclusions

The principle research objectives of this research work is to study of the screw life of rice husk briquetting machine by using different welding rods which are easily available in local market such as Ferrospeed, Duroid Hardcraft650R, Hardcraft 650B and Superinox-1A (Stainless Steel).

1. Proximate analysis and determination of heating value of the rice husk and briquettes shows that, briquettes have more favourable in combustion characteristics than rice husk.
2. Wear and tear of screw height and thickness is directly related with position of the thread in the screw from the exit of the briquettes. First three threads wear rapidly wear than other threads.
3. Life of the screw is increase upto 12 hours when screw is welded by Duroid hardcraft 650R welding rods. Increment on life of screw is 8 hrs, 8.5hrs and 4 hrs when welded by Hardcraft 650B, Superinox-1A, and Ferrospeed respectively.
4. Calculation of net present value, IRR and payback period shows that plant run by screw which is welded by Duroid hardcraft 650R is more feasible than welded by other welding rods.

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