



EXPERIMENTAL ANALYSIS OF DHAL POLISHING MACHINE

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ABSTRACT

Dhal milling systems which have been propagated and are running successfully in the country. The feedback from these users was obtained which indicated that the price of dhal from these machines fetches a lesser price in the market. The basic needs of the polisher were to polish dhal with minimum breakages in a single pass and to consume less power. Accordingly dhal polisher has been designed, fabricated and evaluated. Different prototypes were fabricated and tested for their performance. In addition to the above configurations, trials at three speeds and three loads were also tried out. The efficiency of the mill was calculated and colour of the dhal samples were measured using Hunter colour meter and colour samples were compared with commercial samples. The polisher was found to have an efficiency of 97.7 to 99.5% and the colour of the samples increased by 5 – 10% in the case of green gram dhal and by 2 – 3% for chick pea dhal which was found satisfactory.

Keywords— *dal or daal or dahl, dried lentils, grain legumes*

I. INTRODUCTION

Pulses are one of the highly consumed eatables in India. This is accredited to its palatability and nutritious quality. Pulses are the major source of proteins in one's diet. Hence, they are a must for people of all ages, are especially children in order to attain optimum growth.

India is one of the major pulse growing countries in the world. Among the different pulses grown in the country, the respective share of production has been chickpea (bengal gram/ *chana*) 40.50% , pigeon pea (*tur/ arhar*) 17.90% , green gram (*mung*) 9.20% , black gram (*urad*) 9.10% , lentils (*masoor*) 6.10% and other minor pulses 17.20%.

Table 1 interprets the need of quality in dhal processing

Table 1: House of quality matrix

Interpreted need to technical terms HOW's WHAT's Customer requirements	Perfect process should be selected	Surface finishing	Regular shapes	Cooking properties should be same
It should not loose it's nutrition contents	+1	-1	-1	+1
It should be of good colour and hue	+1	+1	0	0
Less breakages	+1	-1	+1	-1
Easy to cook	+1	-1	-1	+1

Relationship matrix

- +1 = high importance
- 0 = medium importance
- 1 = low importance

PROBLEM DEFINITION

Polishing is one of the important operations in dhal milling process. In dhal polishing the dust or loose small particles and irregularities of the surface is removed and the original colour is achieved. Polishing gives the shining to the dhal and thus improves its eye appeal and economics. Thus polishing is a necessary step in pulse processing. In previous dhal polishing machine multi-pass condition methods was applied in order to increase the degree of polishness of dhal. During multi-pass condition of dhal polishing there were some problems and issues such as maintenance, cost, power consumption. Which has to be resolved, so by keeping in mind the above problems and issues, single pass condition concept is defined and applied for the project.

OBJECTIVES

- Design, fabrication and evaluation of prototypes to polish pulses
- Evaluate performance with different configurations of chamber and polisher shaft
- Evaluate its performance with two types of pulses across speeds and loads

II. DHAL POLISHING MACHINE

Pictorial view of the parts of the dhal polishing machine is given in fig 2. Critical parts of the machine is subjected to analysis as shown in figure 3 and it is found that the design is safe

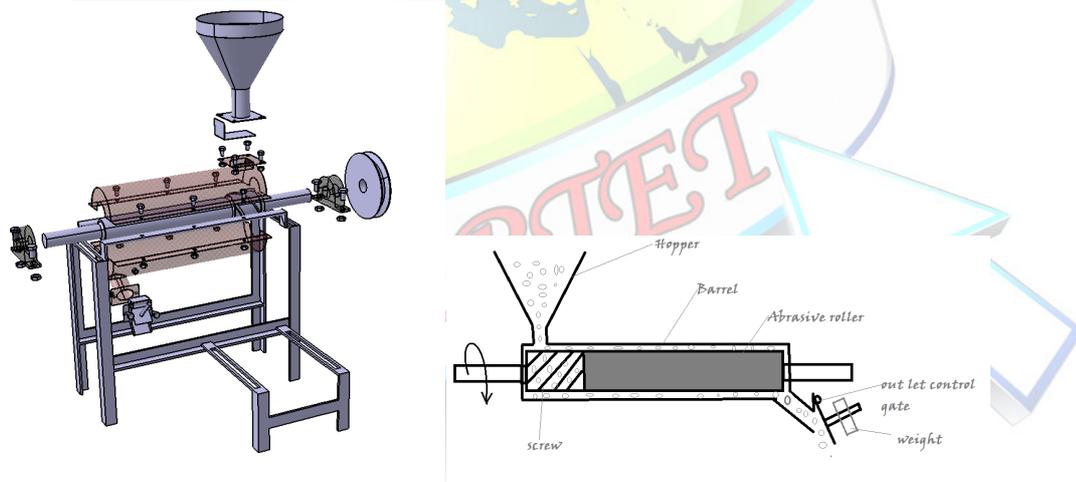


Figure 1: Exploded view of dhal polishing machine

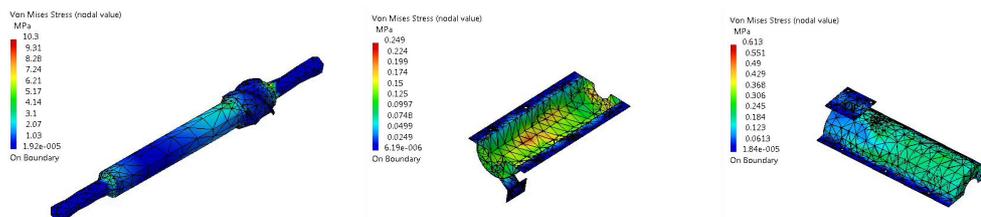


Figure 2 : Analysis results of parts of dhal polishing machine

III. EXPERIMENTAL RESULTS

Performance test of dhal polisher with different configurations of chamber and polisher shaft were conducted to check the following parameters

- Reflectance test of dhal before and after polishing
- Efficiency of the polishing operation
- Power consumption of the unit
- Pressure during polishing of dhal

Experiment 1

- Configuration
 - Roller : Jute roller.
 - Bottom half barrel: Perforated with 1mm hole diameter.
- Flow rate : 15kg/hr,
- Sample : 250gm, *mung* dhal.

Table2: Results of Experiment 1

Sl no.	Roller speed (RPM)	Load (gm)	Actual speed (RPM)	Breakage weight (gm)	Efficiency (%)	Power consumption (KW)	Pressure (gm/cm ²)	Colour test result		
								L	A	B
1	400	50	273	8.3	96.68	194.34	0.021	55.95	6.20	24.96
2	400	70	271	9.2	96.32	199.05	0.035	53.33	6.73	25.46
3	400	85	270	11.2	95.52	200.98	0.039	52.20	6.96	25.86
4	520	50	372	8.4	96.64	213.32	0.016	55.24	6.32	24.42
5	520	70	371	10.1	95.96	215.71	0.021	53.36	6.63	25.24
6	520	85	370	11.4	95.44	224.19	0.035	50.80	7.33	25.35
7	650	50	477	9.5	96.20	232.45	0.008	55.35	6.31	24.31
8	650	70	475	9.9	96.04	238.88	0.017	54.66	6.38	24.94
9	650	85	474	10.4	95.84	253.22	0.035	52.65	6.86	25.61

Experiment 2:

- Configuration
 - Roller : Jute roller.
 - Bottom half barrel: Sheet metal-MS Gauge 20.
- Flow rate : 15kg/hr,
- Sample : 250gm, *mung* dhal.

Table 3: Results of Experiment 2

Sl no.	Roller speed (RPM)	Load (gm)	Actual speed (RPM)	Breakage weight (gm)	Efficiency (%)	Power consumption (KW)	Pressure (gm/cm ²)	Colour test result		
								L	A	B
1	400	50	278	2.1	99.16	191.14	0.0097	65.66	10.46	31.62
2	400	70	279	2.5	99.00	199.60	0.026	65.75	10.59	31.97
3	400	85	276	4.7	98.12	199.81	0.031	65.91	10.47	31.03
4	520	50	368	3.3	98.68	195.51	0.015	66.25	10.41	31.86
5	520	70	367	3.5	98.60	210.93	0.041	66.50	10.16	30.63
6	520	85	367	7.7	96.92	217.33	0.052	66.45	9.95	30.47
7	650	50	474	3.5	98.60	232.19	0.011	65.93	10.39	31.73
8	650	70	473	3.6	98.56	240.02	0.022	65.98	10.55	32.12
9	650	85	472	8.9	96.44	243.12	0.026	66.09	10.59	31.27

Experiment 3

- Configuration
 - Roller : Jute roller.
 - Bottom half barrel: Sheet metal inner jute coated.

- b. Flow rate : 15kg/hr,
c. Sample : 250gm, *mung dhal*.

Table 4: Results of Experiment 3

Sl no.	Roller speed (RPM)	Load (gm)	Actual speed (RPM)	Breakage weight (gm)	Efficiency (%)	Power consumption (KW)	Pressure (gm/cm ²)	Colour test result		
								L	A	B
1	400	50	281	2.2	99.12	211.62	0.019	64.86	10.34	31.69
2	400	70	280	4.5	98.20	218.31	0.035	65.23	10.07	30.30
3	400	85	279	6.1	97.56	229.63	0.060	65.42	9.80	30.24
4	520	50	373	3.1	98.76	222.82	0.012	64.54	10.37	32.28
5	520	70	371	5.5	97.80	232.07	0.029	65.57	10.12	30.85
6	520	85	368	6.2	97.52	235.81	0.038	66.38	9.75	29.32
7	650	50	472	4.1	98.36	242.93	0.009	64.46	10.25	31.44
8	650	70	472	6.2	97.52	252.55	0.021	64.05	10.28	31.16
9	650	85	469	7.0	97.20	257.37	0.029	68.05	9.07	28.59

Experiment 4

- a. Configuration
- Roller : Nylon roller.
 - Bottom half barrel: Sheet metal-MS Gauge 20.
- b. Flow rate : 15kg/hr,
c. Sample : 250gm, *mung dhal*.

Table 5: Results of Experiment 4

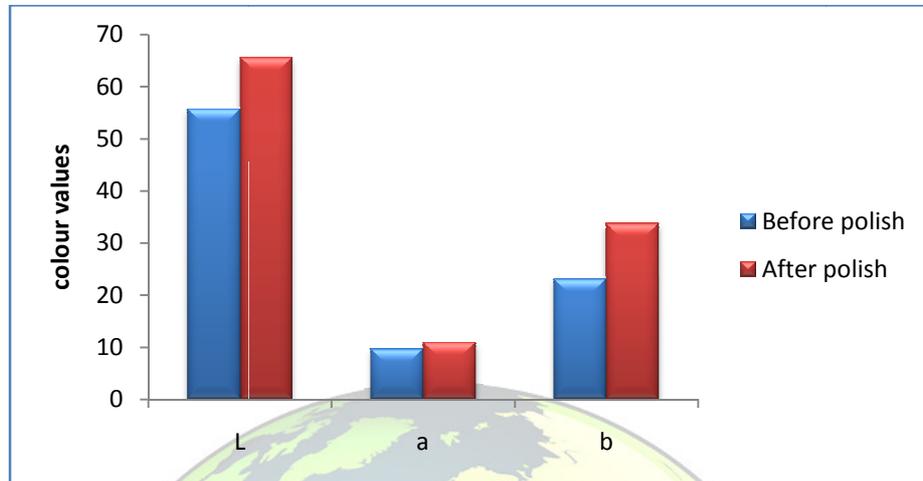
Sl no.	Roller speed (RPM)	Load (gm)	Actual speed (RPM)	Breakage weight (gm)	Efficiency (%)	Power consumption (KW)	Pressure (gm/cm ²)	Colour test result		
								L	A	B
1	400	50	277	3.6	98.56	247.11	0.038	61.25	11.91	33.39
2	400	70	276	3.7	98.52	250.13	0.047	62.96	11.45	33.37
3	400	85	276	4.0	98.40	252.63	0.052	64.74	10.61	32.42
4	520	50	373	2.8	98.88	250.48	0.019	63.89	11.15	33.70
5	520	70	372	2.9	98.84	254.28	0.026	65.60	10.47	33.08
6	520	85	370	4.1	98.36	258.08	0.034	65.29	10.91	33.41
7	650	50	478	1.9	99.24	276.36	0.020	64.48	11.22	33.51
8	650	70	477	3.0	98.80	280.20	0.025	65.29	11.03	32.88
9	650	85	476	3.6	98.56	287.02	0.034	65.55	10.95	33.70

IV RESULTS

The result of reflectance test is measured on through colour values to validate the parameter colour value. Hunter laboratory colour measuring instrument was used. The Hunter L, a, b color scale is more visually uniform color scale. Table 6 shows colour test results for various combinations of additives

Table 6: Combination of additives

Sl. No.	Samples	Colour test result		
		L	a	B
	Commercial market sample	61.68	7.98	26.74
I	Before polish	55.71	9.69	23.10
II	Polish without additives	55.79	9.72	23.36
III	Polish with water (0.1%)	57.23	9.14	22.30
IV	Polish with water(0.1%) + pinch of turmeric powder	56.76	8.58	23.82
V	Polish with oil (0.1%)	53.05	10.46	24.60
VI	Polish with oil (0.1%) + pinch of turmeric powder	58.27	10.92	24.69



Graph 1: Comparison of colour values of unpolished and polished mung dal



Figure3: Comparison of colour values of unpolished and polished mungdhal

V. CONCLUSION

The following are the salient observations:

- The test results indicate satisfactory performance of the dhal polisher for dhal . Thus the objectives set out under the project have been achieved.
- From the experimental results and subsequent observations made it confirms that Nylon abrasive shows better results as compared to Jute abrasive.
- The system when tested for efficiency indicated 97.5 - 98.7% which is highly acceptable.
- Pressure required for polishing was found to be 0.034g/cm² for mung dhal In all the trials conducted, only single pass of polishing was found sufficient. This translates to ease of use in the field or actual site of operation.

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International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
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