Evaluation and Wear reduction of Rice Polisher Milling Roller

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ABSTRACT:

This study is to develop an understanding of the analysis of rice polisher roller to hence the material life of the roller and to reduce the wear rate of roller rice polisher machine wear parts. The wear rate occurs more by the material the rice quality has been damaged. The rice production loss is high in percentage. The process of production loss and material wear rate life improvement has reported in the result in detailed. Improvements of material life and to reduce the material wear rate percentage.

Keywords: Roller, Milling, Polishers, wear, Composite Materials.

I. INTRODUCATION

The modern rice mill machine has reasonable design and the milling efficiency is higher. Quality of the milling machine are directly influence rice quality, including its whiteness, polishing, milling degree of rice and chalkiness, rice grain dimensions, milling and head rice recoveries[1] etc. The Rice milling mills, which are using modern advanced rice mill equipment. This paper present about what we observed in rice polisher machine wear parts [2]. A finding helps to modification of material processing and improvement of material life to reduce the wear.

II. RICE POLISHER

Rice Polishing process is main thing in modern rice milling. In this process bran dust of rice grains has been removed and the head rice has been dispatched. Rice polishing is a continuous operation by this machine parts gets

worn out within year. To control the wear rate and life improvement of the roller modification carried out in material wise to get continues improvement.

III. MATERIAL ANALYSIS OF RICE POLISHER

The performance of roller rice polishers of machine sample1, machine sample 2 and machine sample 3 are recorded during rice mill operation at various places, namely Chennai, Kallakurichi, Chinnasalem and Arni. Analysis of roller of machine sample1, machine sample 2 and machine sample 3 of rice polishers has been carried out for chemical composition, hardness, wear and microstructure.

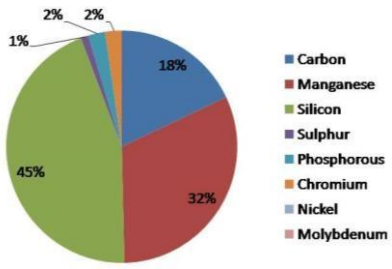
Figure 1: Rice Polisher Roller 1&2 Worn Out Condition

Table 1: Chemical Composition of Roller Samples

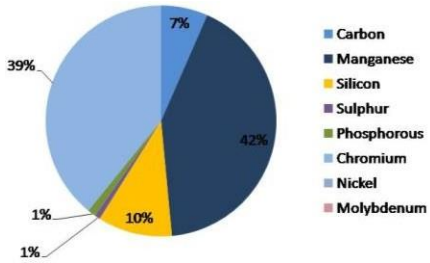
S.No	Elements	MS1*	MS1*	MS2#	MS2#	MS3^
1	Carbon	0.25	0.35	0.21	0.186	0.079
2	Manganese	0.44	1.00	1.22	1.19	1.873
3	Silicon	0.62	0.35	0.35	0.296	1.651
4	Sulphur	0.015	0.060	0.032	0.022	0.039
5	Phosphorous	0.033	0.060	0.035	0.033	0.12
6	Chromium	0.32	-	1.06	1.11	18.0
7	Nickel	-	-	-	-	8.846
8	Molybdenum	-	-	-	-	0.399
Material Identification		EN-8	EN-8	EN10084	EN10084	EN58E

Note: *MS1 - Worn out Roller sample from rice mill, *MS1 - New ROLLER sample. # MS2 - Worn out Roller sample from rice mill, ^ MS3 - Worn out Roller sample from rice mill

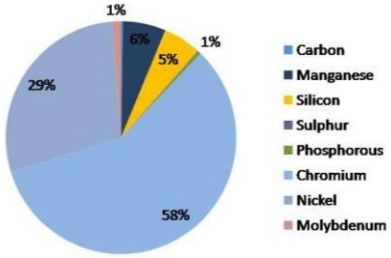
COMPARISONS OF CHEMICAL COMPOSITION OF ROLLER SAMPLES



MS1* Roller Sample



MS2# Roller Sample



MS3^ Roller Sample

IV. SELECTION AND TREATMENT OF STEELFOR ROLLER OF RICE POLISHER

There are mainly 2 types of steels suitable for the rollernamely

1. Plain carbon steels
2. Alloy steels including stainless steel

Plain-carbon steels are the most commonly used steels for structured applications. However the limitations of plain carbon steels are poor hardenability, low corrosion resistance and need quench hardening which initiates surface cracks [3]. More over the toughness and wear resistance will be retained in treated plain carbon steel having carbon content close to 0.65% and beyond[8], toughness is reduced.

Alloys steels are generally classified into four different categories based on the percentage of alloying elements, composition, microstructure and applications.

1. Classification based on percentage of alloying elements

    a) Low alloy steels (total alloying elements less than10%)
    b) High alloy steels (alloying elements 10% - 50%)

2. Classification based on composition

    a) Nickel steels
    b) Chromium steels
    c) Chromium nickel steels
    d) Chromium nickel molybdenum steels
    e) Stainless steel (Cr >10%)

3. Classification based on micro structure

    a) Ferritic steel
    b) Martensite steel
    c) Austenitic steel
    d) Bainitic steel

4. Classification based on application

    a) Corrosion resistance steel
    b) Heat resistance steel
    c) Magnetic steel
    d) Tool steel
    e) Electrical steel
    f) Wear resistance steel

Both plain carbon and alloy steels of suitable grades, heat treated to proper hardness and toughness, to increase core strength and surface treated to higher hardness for increasing wear and corrosion resistance [10], can be selected for roller. There are many such grades of standard steel available in the market, out of which steels selected for roller should be able to withstand rice polishing load, wear and impact to ensure an expected life of around, 3 years of operation at full load.

Criteria for the selection of steel suitable for roller

1. Comparison of life of roller of different ricepolishers
2. Chemical, microstructure and hardness analysis ofroller.
3. Wear behaviour and failures of rollers.
4. Strength and wear resistance required.

Chemical, microstructure and hardness analysis ofRoller

The chemical composition, microstructure and hardness of the roller are important for their performance in rice polishing. These details have to be considered to get good life for the roller. Roller of rice polishers are made of anyone of the two types of steels, carbon or alloy steel [8]. When one of the above types of steel is selected for roller, it has to be suitably heat treated to get the desired mechanical strength and toughness to withstand the rice polishing stresses by maintaining desirable microstructure.

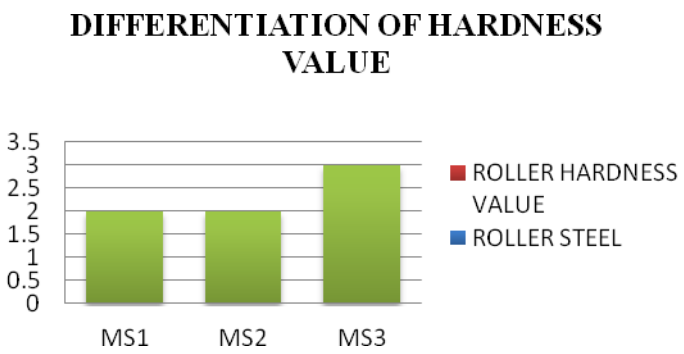
V. ROLLER STEELS

Carbon content in carbon steels close to 0.65% helps to increase wear resistance and toughness, but these steels have to be quench hardened because of its poor hardenability. The corrosion resistance of carbon steel is poor. Alloy steels, overcome the limitations of carbon steels for cam by improved strength without loss of toughness, hardenability, corrosion resistance wear and fatigue resistance. Chromium, nickel and molybdenum help to increase strength, hardness, toughness, corrosion and wear resistance.

The tested report of roller MS1*, MS1*, MS2#, MS2# and MS3^collected from rice mill are tested for chemical composition, microstructure and hardness and recorded. The chemical analysis of MS1* reveals that the roller is made of low alloy steel, EN8 heat treated to a hardness of 47 HRC.

The chemical test reports of MS2# indicate that the roller steel is case hardening alloy steel, EN10084.MS2# roller has a hardness of 22 HRC in fully worn out condition.

MS3^ cam as tested conforms to Chrome-Nickel alloy steel, EN58E and has surface hardness of 435 HV and core hardness of 186 HV.



VI. RECOMMENDATION OF STEEL FORROLLER OF RICE POLISHER

The chemical composition, microstructure and hardness of roller are important for their performance in rice polishing. These details have to be considered to get good life for roller. Roller of rice polishers are made of anyone of these two types of steels; carbon or alloy steel. When one of the above types of steels is selected for Roller, it has to be suitably heat treated to get the desired mechanical strength and toughness to withstand the rice polishing stresses by maintaining desirable microstructure.

The food grade stainless steel of strength higher than 44.25 Kgf/mm2 has to be selected for roller and it is AISI 304 of strength 51.5 Kgf/mm2 which is corrosion resistant chromium-Nickel austenitic stainless steel whose wear resistance can be increased by surface treatment of carbon nano tube coating to microhardness of 1600-1800 HV, case depth of 200 microns.

VII. Conclusion

Rice polisher wear parts, namely, rollers been studied at the mills for their performance and life. The wear studies had been carried out on roller which is the major replaceable components of the rice polishing machine. The Roller of rice polisher machine has high wear rate and lower material life. Improvement of material life and reduce wear rate of the material. It has been focused to achieve 20-25% enhancement in performance of wear parts of rice polisher. The food grade stainless steel of strength higher than 44.25 Kgf/mm2 has to be selected for roller and it is AISI 304 of strength 51.5 Kgf/mm2 which is corrosion resistant chromium-Nickel austenitic stainless steel whose wear resistance can be increased by surface treatment of Carbon nanotube coating has been applied the roller material. To microhardness of 1600-1800 HV, case depth of 200 microns. By this process the 70%-85% life of the rice polisher roller material can be get improved.

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