

Design and Development of Quadra Chakki Mill

A mill that can save 40% of power and space with food safety enhancement

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Abstract: Wheat is one of the oldest foods in the world. Its discovery helped transform Homo sapiens from hunter-gatherers into farmers. The grinding process is the most important step in milling. The milling process affects the nutritional value and quality of the flour. The main objective of the study is to design wheat flour mill with emery stone to answer the problem of power consumption in wheat mills and decrease it by 40% and reduce their size in order to save space. Experimental research approach is used in this study. It is an attempt by the researcher to maintain control over all factors that may affect the result of an experiment.

I. INTRODUCTION

Wheat is one of the oldest foods in the world. Its discovery helped transform Homo sapiens from hunter-gatherers into farmers. The grinding process is the most important step in milling. The milling process affects the nutritional value and quality of the flour. Lower heat methods result in a nutritionally superior flour. The way that the kernel is broken impacts of the grinding processes. The four main forces used in grinding are compression, shear, friction/abrasion, and impact. Some of the most common grinding machines are roller mills, attrition mills, impact mills, ball mills, cutters, disc mills, bran dusters, and pearlers.

Once the wheat is prepared after cleaning and tempering it has to go to milling which is defined as the process by which cereal grains are ground into flour. This is the separation of bran & germ from the endosperm & the reduction of endosperm to a uniform particle size i.e. flour. The whole milling process is repetition of two main processes, grinding & sifting. Finally, the mill ends up with fine bran & flour. Further steps are storage, packaging & delivery. The milling process is not an easy task to visualize, it requires quite special skills. "Uniform quality in milling is stability" and it shall not be forgotten. Stability starts with grain handling & continues till the milling process ends. The miller is responsible to fulfill all the requirements at every stage of grinding process. A successful milling will produce flour of consistently high quality. Customers judge the quality of flour based on three factors: Purity & lack of contaminants, Fineness, Correct weight in pack. In addition

to checking the quality QA (quality assurance) program has to be organized.

II. FUNDAMENTALS OF GRINDING

Normally, the types of grinding process we opt are single stage & multi stage grinding. Before proceeding to describe the grinding machinery, the fundamental principles of the most important operation in the industry must be systematically considered.

In classifying the types of milling machinery existing in modern techniques, according to the principles of action of their working organs upon the product under treatment, the machines must be divided into the three following categories :

- (1) Cutting (chipping off) machines
- (2) Pressing (crushing) machines
- (3) Machines acting by free impact.

Perhaps counter-intuitively, millstones do not touch when in operation. There is a gap between the static bed stone and rotating runner stone which is determined by the size of the grain. Grain is fed from a chute into a hole, known as the eye, in the centre of the runner stone. An intricate system of groves known as furrows distributes the grain across the millstone surface, and also serve to ventilate and cool the millstones. The grinding surfaces of the millstones are known as lands and are divided into areas called harps (see accompanying diagram). Once ground the flour passes along narrow groves called cracking, and is expelled from the edge of the millstones.

III. STONE MILLING

The traditional Stone Ground method grinding of wheat between stones is used to develop a flour of the highest quality. It is slow process that helps to retain the flours natural state of minerals, vitamins and proteins.

The stone ground flour motto of, "nothing added nothing removed" means exactly that. The goodness that goes in the top of the mill, is what comes out at the bottom. The Stone Mills flour is stone ground in a very special way. This stone grinding process ensures a particularly natural and healthy end product. No iron or preservatives or any other colours or bleaching agents have been added. The stone mill is one of the original mills used for grinding wheat, uses a combination of compression, shear, and abrasion. The grinding action occurs between two stones. The material is fed into the center of the top stone, which is fixed and does not rotate. The bottom stone is driven by a drive mechanism. The grinding gap between the stones is adjusted with a hand adjustment that raises and lowers the stone. The raw wheat material is then ground between the stationary and moving stone and the material is pushed radially to the circumference by grooves and furrows cut into the face of the stone. The ground material is discharged by the rotation motion and is conveyed out by the furrows.

Chakki milling in India is almost same as Stone milling in the western world. The basic principal of Stone milling is same as the Household Chakki milling. There are enhancements like automatic control of the spindles to adjust space between the disks. The process results in 17% to 20% starch damage and no loss of Ash.

IV. QUADRA MILL

A. Concept

Quadra mill allows to perform the grinding process easily and automatically. The Quadra mill has been designed in such a manner that will help you in reducing production time and improving the quality. The Quadra Mill is more powerful, longer lasting, higher quality and performs better than any other Electric Grain mill on the market.

Main purpose of innovation is to provide:

40% Power Saving over the conventional Mills
40% Space Saving Over the Conventional Mills
Lesser Sound
Height Food Safety
The high-tech grinding machinery Effective and efficient
Reduce Dependency of Human Resource
Improve the Product Consistency
Bench Mark Data

B. Design

- **BODY DESIGN:** With the help of 3D Computer Added service, design for Quadra mill was done for better efficiency and less vibration, enclosed body for good sanitation and lesser sound. Sturdy frame made of hollow pipe for lesser vibration. The design of Quadra Mill body is fully different as compared to the conventional Flour Mill.
- **MOTOR FITMENT:** Development of a Horizontal fitment is done for improved bearing life. This Horizontal fitment shows the difference of conventional flour and Quadra Mill. There is 25 HP Electric motor for power engine.

- **DRIVE:** Gear Drive which can run two mills at a time for better use of power. The Gear Drive – Heavy Duty Spiral Bevel Gear Suitable for above mill 90 degree input 960 RPM 1:2.2 ratio, hollow output. Complete with Coupling and main Shaft. The drive used by us in the Quadra Mill is first time used in the flour mill history .
- **TECHNOLOGY:** Creation of company's own new edge PLC technology in the Quadra Mill for maximum saving of electricity consumption and also cost cutting. PLC and HMI unique codes for using AI.
- **STONE GAP SYSTEM:** In the Quadra Mill there is an Automatic Stone Gap Adjustment system for Stone Chakki sliding system. PLC controls the system for auto stone disengaging and disengages the stone when required and as well the operator can also press the emergency switch to operate the stone disengaging system.
- **FOOD SAFETY PARAMETER CHECKING SYSTEM:** In Stone milling ash content and bran percentage is concerned for food safety. We have developed a system to control ash and to check Bran % with NIR for controlling the extraction of bran percentage.
- **SELF-DIAGNOSIS SYSTEM:** A unique algorithm to check on mills health and safety to decrease maintenance time.

C. Abbreviations and Acronyms

NIR- Near Infrared

PLC- Programmable Logic Controller AI- Artificial Intelligence

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