PROJECT REPORT ON THE MANUFACTURING PROCESS OF ROTARY TILLERS/ROTAVATORS

(AGRICULTURAL AND MECHANICAL ENGINEERING)

ABSTRACT

One of the most promising manufacturing technologies nowadays is a rotary tiller which is a mechanized agricultural implement popularly used to save time, human effort and fuel, in preparation of a soil bed. In the pre-launch phase, manufacturing systems are focused on developing and preparing the production processes for the product, involving designing and testing the manufacturing equipment, establishing supply chains, and optimizing production workflows.

The rotary tiller, a robust and versatile machine, is meticulously engineered to enhance soil cultivation practices. Its primary objective is to break up compact soil hence effectively preparing it for sowing seeds or transplanting crops. Equipped with a series of rotating blades or tines, the rotary tiller effortlessly swirls and pulverizes the soil, ensuring optimal aeration and nutrient distribution. By using rotary tillers, both primary and secondary tillage applications can be combined in one stage.

By :- Aarav Prakash, The Doon School

Osaw Udyog, Ambala Cantonment, India

Date: 9th July 2023 – 23rd July 2023

INTRODUCTION

ROTARY TILLER

- A rotary tiller is a specialized mechanical tool that is used to plough the land. It consists of a series of blades that are designed to swirl up the earth, effectively breaking it up and preparing it for planting. One of the key advantages of a rotary tiller is its ability to be adjusted according to the specific requirements of the soil. This means that it can be used in a variety of soil types, from heavy clay to light sandy soil.
- In recent years, the use of rotary tillers in agricultural applications has increased significantly. This is due to their simple structure and high efficiency when it comes to tillage. By using a rotary tiller, farmers are able to combine both primary and secondary tillage applications in one stage, saving time and effort.
- However, it is important to note that rotary tillers do consume a significant amount of energy. This is especially true in heavy loam soils, which require more power to break up. In order to address this issue, numerous studies have been conducted to design blades that are more energy-efficient and reduce power consumption.
- The primary use of a rotavator tiller is in agriculture, specifically for loosening the upper layer of soil to create a seedbed. The rotavator has a higher soil mixing capacity compared to other plough machines, and it also has excellent weed-cutting capabilities. This leads to improved water-air, thermal, and nutrient conditions in the soil.
- One of the advantages of a rotavator is its versatility. It can be easily adjusted for various working depths and soil finishes, allowing farmers to customize their tillage operations. The rotating blades of the rotavator also chop and mix residues evenly throughout the working depth, providing better soil preparation compared to other implements.
- Overall, a rotary tiller, or rotavator, is an invaluable tool in modern agriculture. Its efficiency in ploughing the land and improving soil conditions has made it a popular choice for farmers worldwide.
- A rotary tiller is a tractor-drawn implement primarily used for preparing the soil for planting seeds. Its effectiveness in removing and mixing leftover plant material from crops like maize, wheat, and sugarcane enhances the quality of the soil. Additionally, this process offers numerous benefits such as saving fuel, reducing costs, saving time, and conserving energy.
- One of the key advantages of a rotavator is its ability to operate in both forward and reverse directions, providing versatile functionality. This allows farmers to manoeuvre the machine easily and efficiently in various field conditions. The gearbox of the rotary tiller enables the operator to adjust the speed of the machine while ensuring that the blades continue to rotate at a consistent rate.
- In conclusion, the rotary tiller plays a crucial role in modern agriculture by facilitating efficient soil preparation and improving soil conditions. With ongoing advancements, these machines can become even more sustainable and efficient, benefiting farmers worldwide.

COMPONENTS OF ROTARY TILLER AND FORMULA USED FOR WEARCALCULATION

1. **Three Point Frame** allows for easy attachment and detachment of the rotavator to the tractor. Its robust construction and reliable functionality make it an indispensable component for farmers and agricultural workers, ensuring smooth and efficient operation in the field.

2. **PTO/Rotor Shaft** acts as a link between the tractor's engine and the rotavator, enabling the transfer of rotational energy. It is designed to efficiently transfer power from the tractor's engine to the rotavator, ensuring smooth and effective operation.

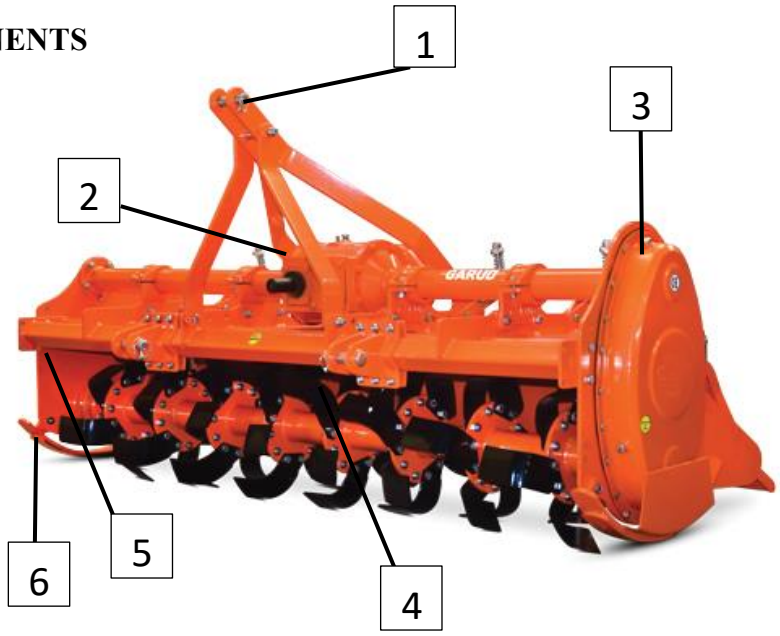
3. **Side mounting Plate** refers to a protective covering that is installed on the side of a rotavator, specifically designed to shield the driving gears of the machine.

4. **Blades** can be L, J or C alphabetically shaped, which provide tillage function for various purpose, blades get drive from gears mounted having driving source PTO of tractor.

5. **Mudguard:** The mud guards act as a shield, these crucial moving parts, the mud guards not only enhance the longevity and durability of the rotavator but also contribute to its optimal performance. Without the protection offered by the mud guards, the constant exposure to mud and debris would gradually wear down the components, leading to increased friction, decreased efficiency, and ultimately, mechanical failures

ROTARY TILLER WITH SIX COMPONENTS

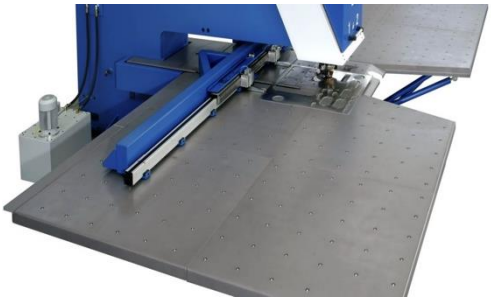
1. Independent Top Mast
2. Single / Multi Speed Gear Box
3. Chain / Gear Drive
4. Six Blades per flange
5. Adjustable depth skids
6. Central with offset positions



MANUFACTURING PROCESS OF ROTARY TILLER / ROTAVATOR :

The manufacturing process of a Rotary Tiller / Rotavator involves using metal sheets as raw material. These sheets are cut, bent, and assembled to create the implement, onto which other working parts are mounted. Each manufacturing process consists of various sub activities that are associated with the main activities being performed. All of these manufacturing processes take place at a designated station within the industry. Manufacturing processes are discussed as following:

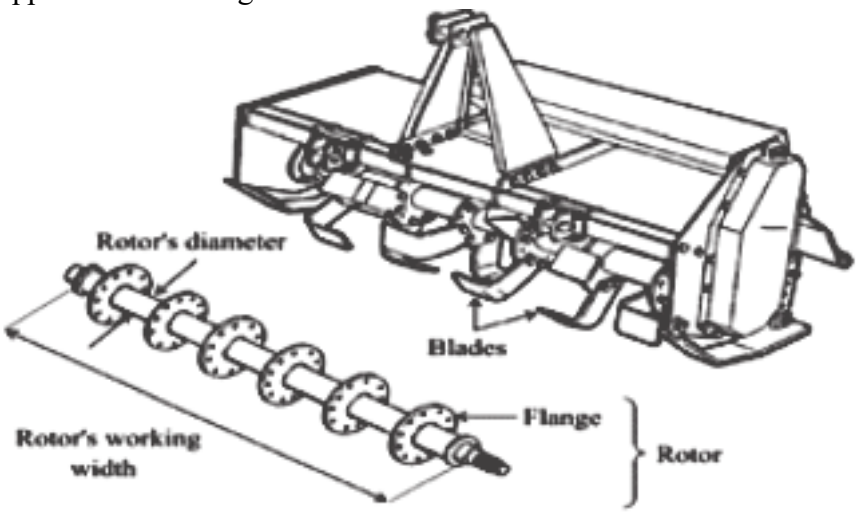
- Sheet cutting and bending



Sheet Cutting

Sheet Bending

- Rotor Mounting : Facing of plates and development of side cover mounting, uppercase mounting



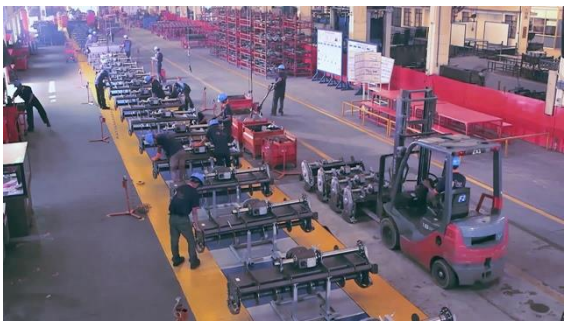
Tillage Components of a Rotary Tiller

- Painting

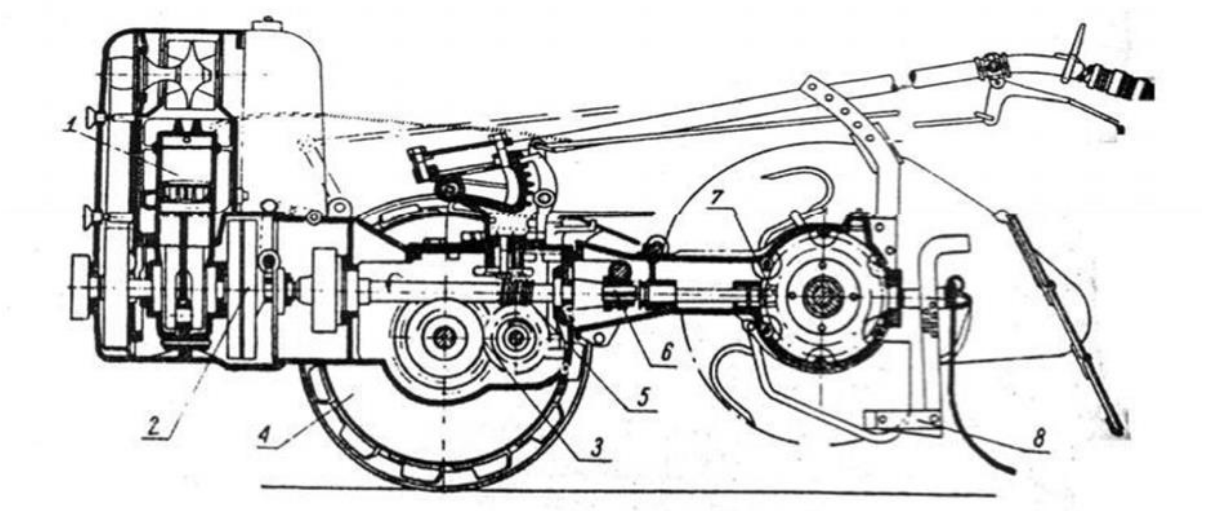
Assembly line painting

Powder Coating of a Rotary Tiller

- Final assembly and inspection.



A group of men working on assembling the machine



Process 1
Sheet Cutting

Process 2
Sheet Bending

Process 3
Side plate mounting

Process 4
Rotor Manufacturing & installation

Process 5
Facing of Plates

Process 6
Under case development

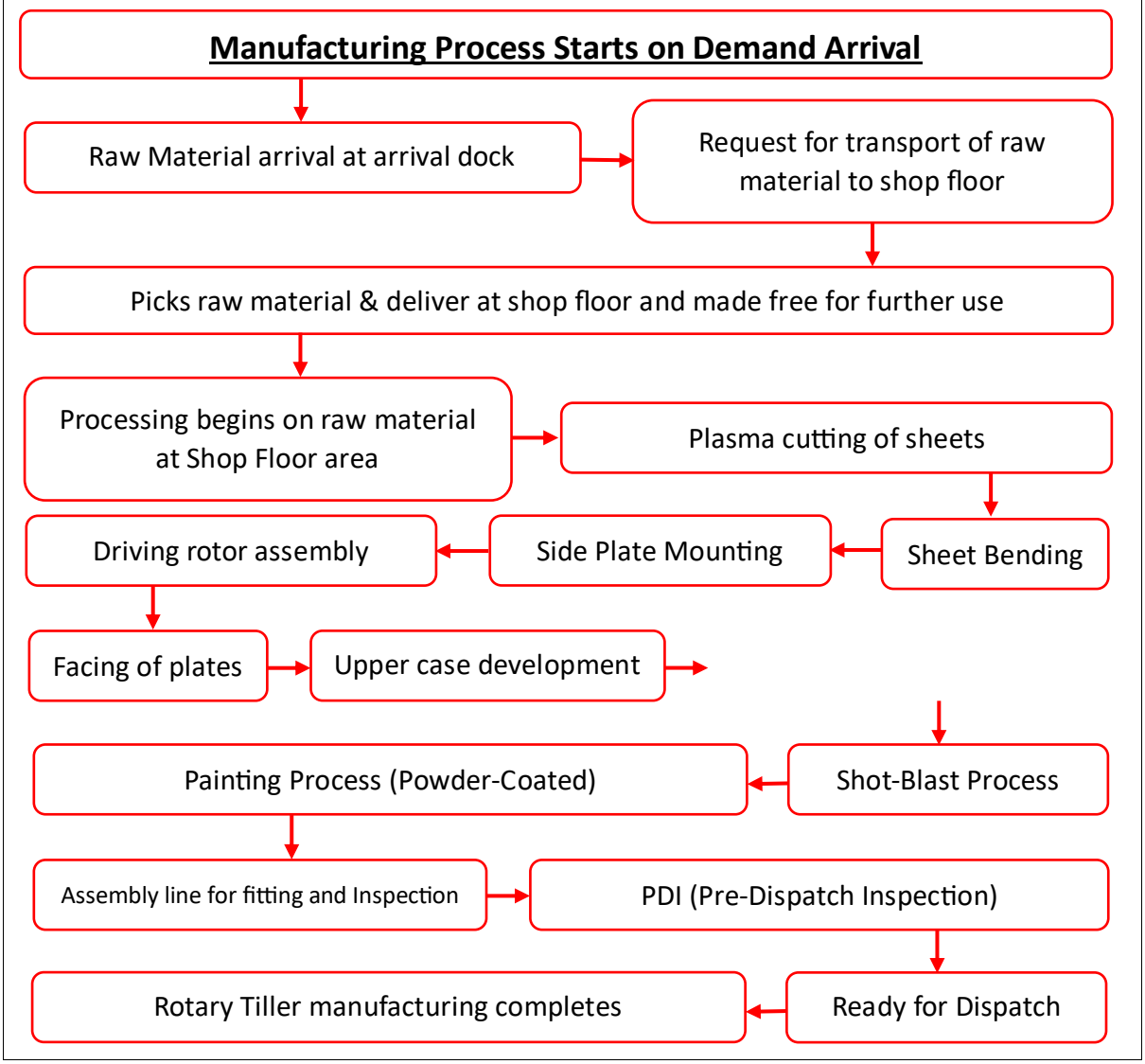
Process 7
Mudguard Mounting

Process 8
Painting

Process 9
Fitting & Inspection

MODELLING AND SIMULATION OF MASS PRODUCTION SCENARIO FOR ROTAVATOR MANUFACTURED BY: OSAW UDYOG PVT. LTD.

ROTAVATOR MODELLING AND SIMULATION LOGIC



Complete run-time for all manufacturing processes for completion of a Rotary Tiller

Runtime	Operation Time	Resources Used	Operation Time
Step 1	Sheet Cutting	Plasma sheet cutting machine	5 hours
Step 2	Sheet Bending	Sheet bending machine	15 minute/piece
Step 3	Side plate mounting	Jigs for locating mounting holes Arc welding	30 minute/piece
Step 4	Rotor Manufacturing	Arc welding CNC Operation Drilling MIG welding	30 minute/piece 3 minute/piece 10 minute/piece 15 minute/piece
Step 5	Facing of Plates	Lathe Machine	5 hours/piece
Step 6	Upper case development	Plasma Cutting machine sheet bending machine jigs for locating mounting holes	30 minutes/piece
Step 7	Mudguard Mounting	Pre-assembled mudguards	15 minutes/piece
Step 8	Shot-Blasting Process	Shot-blasting for removing any rust to provides a smooth and durable finish	2 hours/piece
Step 9	Painting	Powder-coated paint	2.3 hours/piece
Step 10	Fitting	Final assembling tools and inspection	2.3 hours/piece

1. The commencement of this process is initiated by the arrival of customer demand and raw materials in the form of sheets, characterized by a thickness of 5mm and 10mm.

2. Initially, the raw material is transported to the arrival dock of the processing facility, whereupon it is subsequently transferred to the shop floor to commence the processing operations.

3. The raw material is readily accessible at the processing stations, where it undergoes an initial stage of being cut into multiple sizes by a plasma cutting machine.

4. After the sheet is cut, it undergoes a bending process using sheet bending machines to achieve the desired shapes.

5. The next step involves mounting the side plate over the driving gears. The side plate serves as a protective covering for the driving gears, ensuring their smooth operation and preventing any potential damage. The mounting process requires careful precision and attention to detail to ensure a secure and reliable attachment.

6. The rotor that is used to drive the rotavator is now mounted. This step is an essential part of the overall operation sequence, which includes welding, CNC operation, and drilling.

8. Upper case development is a comprehensive and efficient operation that involves the collaboration of various machines, namely the plasma cutting machine, sheet bending machine, and jigs. This sequence of operations is crucial in achieving the desired outcome and encompasses all the necessary steps required to transform raw materials into a perfectly crafted upper case.

9. The mudguard is a product that is carefully manufactured, with each piece requiring a precise production time of 15 minutes. This attention to detail ensures that every mudguard is crafted to the highest quality standards.

10. The shot-blasting process involves propelling small steel balls, known as shot, at high velocity onto the surface of the parts, this removes any rust, scale, or other contaminants from the surface, ensuring that the paint adheres properly and provides a smooth and durable finish.

11. The process of painting individual parts is now completed, and it takes approximately 2.3 hours to powder-coated paint each piece.

12. The final fitting and inspection process is a crucial step in completing the manufacturing of the product. This stage ensures that all components are properly assembled and aligned, and that the product meets the required quality standards. During the final fitting and inspection, skilled technicians meticulously examine each piece to ensure that it is free from any defects or flaws. They check for proper alignment of parts, functionality of mechanisms, and overall appearance. Any necessary adjustments or corrections are made to ensure that the product is in perfect condition.

13. The newly manufactured Rotary Tiller is now ready to leave the plant. To facilitate its movement, the Rotavator requests the assistance of a tractor mounted crane. The crane is responsible for lifting and transporting the Rotavator from its current location within the shop to the designated exit point. This final step ensures the smooth transition of the Rotavator from the manufacturing process to its subsequent distribution or use.