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Grass and Leaf Fiber Plate Making Machine

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Abstract: Polythene, polypropylene, polystyrene, polycarbonate are used to disposable plates which may cause health risks due to the release of toxic/dangerous chemicals such as bisphenol A, melamine, vinyl chloride, and phthalates. The usage of disposable plasticware depletes fossil fuels and also causes microplastic pollution. Hence it is high time that we shift to move to biodegradable materials. In India leaves like banana, areca has traditional values. They are also signified in religious functions Various leaves are used as dining plates, food wraps during steam cooking, grilling and frying of varied dishes, and food packing. In today's world, automation is the need for even a small-scale industry. Hence making the production of leaf plates automated increases the production rate, quality, efficiency etc. This is chemical free manufacturing process. Hence Carbon footprint from these leaf-based products is very minimum when compared to other disposable alternates in the market. Next important part is the raw material procurement, in leaf plates only specific types of leaves are used which leads to a shortage of raw materials which affects the production rate during high demand. Since this project is based on extracting fibres from grass and plant leaf (agricultural waste), it does not limit our source to a particular ingredient. Therefore, there will be an abundant raw material for our application and there will be high productivity as per the requirement and it is one of the effective methods to replace plastic wastes.

Keywords: Agricultural waste, Bio degradable, waste management.

I. INTRODUCTION

The disposable plates, cups, tumblers are generally made up of various polymers such as polythene, polystyrene and other similar polymers. This may cause health risk. Also the disposing same is a long term problem as they are not biodegradable and in most of the places, these disposable plates are not properly disposed. If disposable products are made from biodegradable products the problem in disposing them after its use would solve. In order to address this issue, an attempt is made to develop biodegradable disposable cups in an agricultural waste. However problem with biodegradable products are their shelf life is low as they are prone to bacterial attack.

Various researches have been done on utilizing the agricultural wastes into useful products. Shen et.al [1] talks about blueberries antimicrobial properties which could utilized in order slow down the biodegradation process. Vieira et.al [2] talks about natural plasticizers which could be used in order to make new packing materials. Pirayesh et.al [3] talks about using walnut waste as wood particle-based particles. The authors were successful in showing that waste of walnut can be used as an alternative for wood. Erdohan et.al [4] talks about characterization of PLA based antimicrobial coating. The same could be utilized where ever there is need to minimize biodegradation. Nagarajan et.al [5] talks about the sustainable bio composites. The authors developed composite materials from bio waste. The developed composite material was having a very high strength to weight ratio.

II. DESIGN

Among various agricultural wastes, sugarcane grass waste was selected as a material which would be processed to make bio degradable disposable cups. The Process involves in fibre processing, conversion of same into useful disposable products by heating and compressing in required die.

A. Fiber Processing

For example, 100 kg of fresh grass contains 17 kg of dry material and 83 kg of water. This 17 kg of dry material makes up the cell wall made up of fiber and the 83 kg of water makes up the cell contents such as sugars, proteins, minerals, oils, etc.

These grasses used here are in dry condition and are processed in an extruder machine by mixing them with water. Extrusion is when a material, usually pellets, dry powder, rubber, plastic, metal bar stock, or even food is heated and pushed through a die.. For example, our breakfast cereals and pre-formed snacks are often made using food extruders that use uniform, controlled pressure and temperature to create the near-identical pieces we pour into our bowls each morning. The compounding action taking place inside the extruder and also due to the heat generated, the cell contents as mentioned above are separated from the cell wall by the simultaneous cutting, mixing, and conveying process.

The separated cell contents are dissolved in the water and the separated fibers are obtained in the form of thin strings, which are then sent for the next process. The fibers obtained from the extrusion process are next sent to a chopping machine that cuts the fibers of required sizes which may range from 1 mm to 5 mm. These chopped fibers are mixed in a solution of water and AKD wax and placed inside a stirring machine. The stirring machine is set at a constant speed of rotation so that the AKD wax and the grass fibers will adhere to each other. Roughly around 4 hours of stirring time are considered for sufficient adhering to take place.

B. Die and Punch Design.

1) The die and punch were designed according to the shape of the output of the product. The CAD design of punch is shown in the fig The punch was made from plain carbon steel for prototype. The punch would be heated using CAD design of die is shown in the fig 2.The die was made from Aluminium for prototype.

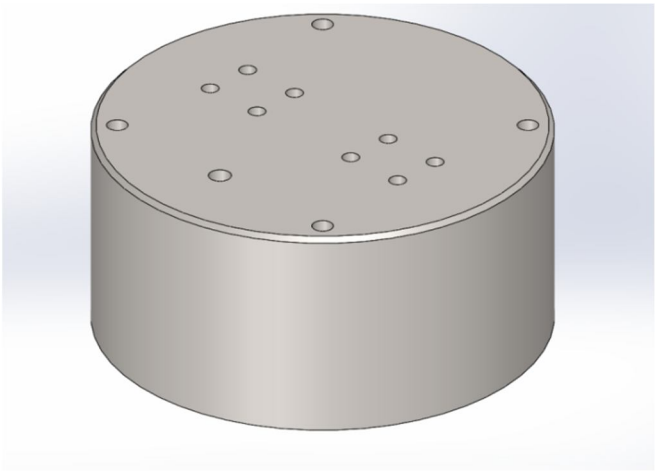


Fig. 1 CAD model of punch

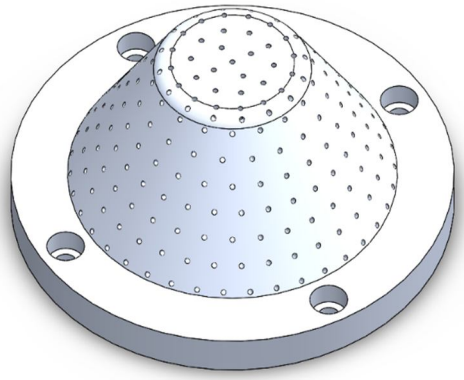
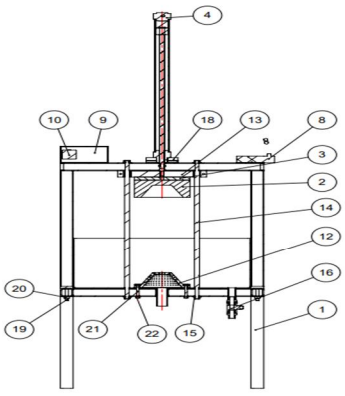


Fig. 2 CAD model of die

C. Design of Punching Machine

Full punching machine was designed. Pneumatic cylinder was used for this purpose. Apart from pneumatic cylinder, vacuum pump was used for the purpose for suctioning. The vacuum pump will be connected to the die. The vacuum suction will be used from the holes in die. Similarly the punch would be heated to high 180ºC using the coils which would be inserted in the holes on punch. The full setup CAD model is showed in fig 3.

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	RD00101008	BASE	1
2	RD00101004	DIE	1
3	RD00101003	TEFLON PLATE	1
4	STD	PNEU. CYLINDER	1
5	STD	THERMOCOUPLE	1
6	STD	HEATER	4
7	STD	ELBOW 1/4M BSP	4
8	STD	HAND OPARETED VALUE	1
9	STD	JENCTION BOX	1
10	STD	CONTROLLER	1
11	STD	gasket	1
12	RD00101005	PUNCH	1
13	RD00101002	GUID PLATE	1
14	STD	GUID ROD	2
15	STD	NUT-M12	4
16	STD	BALL VALVE	1
17	STD	HOSE ADAPTOR	2
18	RD00101007	MTG PLATE	1
19	STD	HEX BOLT M10X70	4
20	STD	NUT-M10	4
21	STD	HEX HD CUP SCREW M8X60	4
22	STD		4
23	STD	HEX HD CUP SCREW M5X16	4
24	LOCKING BUSH11	XXXXXX	1
25	STUD11	XXXXXX	1
26	SPRING FOR TC11	XXXXXX	1



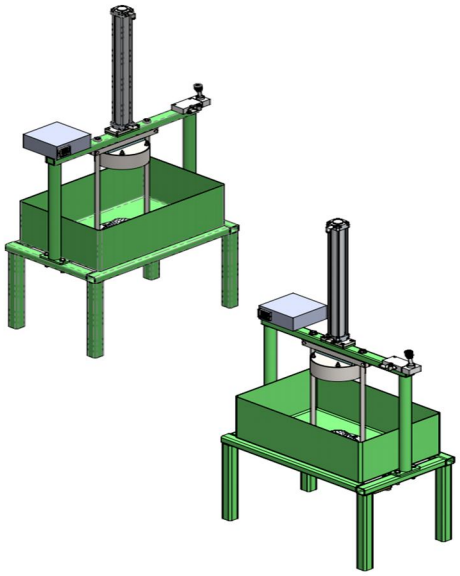


Fig. 3 Full system CAD model

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III. FABRICATED SYSTEM

The designed machine was fabricated and trials were conducted on same. The fabricated and assembled system is shown in the fig 4. All elements were made according to list given in the fig 3. The same was assembled.

Fig. 4 Fabricated system and full assembly

IV. SAMPLES

The trial run was performed on the machine. The sample is shown in fig 5. The sample was found to be ok.

Fig. 5 Samples

V. CONCLUSION

The sugarcane grass waste has been successfully converted into useful disposable cups. The same can be easily commercialized. The production version requires some more improvements hydrophobic properties. The finish of the end product also could be improved using Teflon coating on dies. Similarly different dies could be developed for various other shapes of disposable products.

VI. ACKNOWLEDGEMENT

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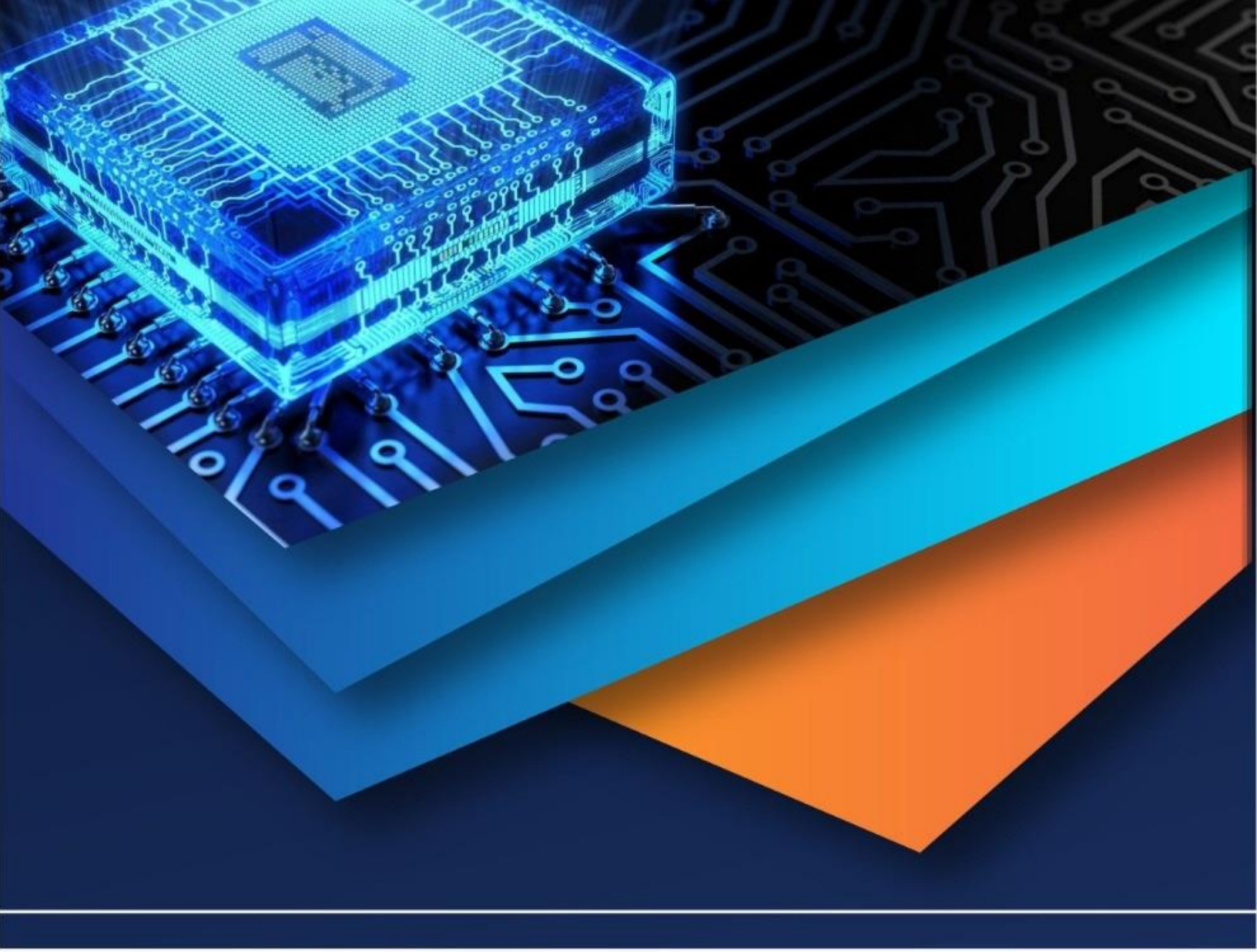

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