THE DESIGN & BUILT OF CRUSHER MACHINE PLASTIC BOTTLES

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ABSTRACT
Nowdays PET recycling technology is a most mature and common case among all polymers. Recycled PET can be used again to produce PET-based plastic Products, e.g. bottles (not food & beverage-grade), fiber/cloth, sheet, strap band and, etc. However the plastic bottle cannot be biodegradation by our nature and if we try to burn, the combustion will produce an hazardous gas that really dengrous to human and environment. So to overcome the problem, plastic bottle must be recycled with a right way. Alternatively, a medium sized of mobile crusher machine has been designed which it works for crushing plastic bottles. Improvements were made to the hopper, tools and the use of electric motor.

Keywords: Crusher machine, plastic bottles, hopper, tools, electric motor

1.0 INTRODUCTION
Recycling is the process of treating waste materials to produce new products. Recycling reduces waste, reduces consumption of new raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from landfill) and reduce greenhouse gas emissions from the production of new goods from raw materials. Recycling is a key component of modern waste management and the third component of the “reduction of waste, Reuse, Recycle “waste hierarchy(Lyons & Burford, 1993)The material can be recycled, including most types of glass, paper, metal, plastic, textiles, and electronics. Although equally effective, producing compost or other use of biodegradable waste - such as food waste or surplus garden - usually not considered recycling. Materials to be recycled either brought to the collection site or collected from the streets and organized, clean, and reprocessed into new materials for manufacturing. In a real sense, recycling of waste materials would produce a fresh supply of the same material, for example used office paper used to produce the new office paper, or used polystyrene is used to make other polystyrene. However, this is often too difficult or too expensive (compared with producing the same product from raw materials or other sources), with the majority of the goods or materials “recycle” otherwise involve the use of other materials to produce (Vanessa, 2007). The existing Plastic bottle crusher still has many deficiencies in terms of operational and efficiency of a machine. This possibility of a relatively large Hooper design, tool selection and use of the driving motor. Design Hooper must have appropriate and
good balance when the plastic bottles put it also affects every movement of the tool, if the plastic bottle is stuck it will cause the machine cannot operate properly.

The selection of tool also contributes to the efficiency of the machine and the results can be seen on crushing results in term of scroll size. Furthermore, the selection of the right motor should be considered carefully because it will affect the efficiency of the machine is operating (J.D Edwards, 1991). As a solution, a medium-sized machine has been designed which is capable of crushing a plastic bottle with a rate of six bottles per minute. The size of the scroll is in the range of 10 to 20 mm. The use of this machine can be extended to small and medium industries. In addition, full-time housewife can also recycle plastic bottles enterprises operate on a small scale to the household income.

2.0 REVIEW OF CRUSHER MACHINE

In the recycle industry, the component must be crushed or melted to form a pallet. Therefore, the plastic bottle must be cut into smaller pieces appropriate with the machine condition before transferred to the further process, such as injection molding (Vanessa Goodship, 2007). There are two system used in crushing machine, namely impact system and rotary system.

2.1 Definition of PET Bottle

Polyethylene terephthalate, commonly abbreviated PET, PETE, or the obsolete PETP or PET-P, or referred to by the brand name Dacron, is a thermoplastic polymer resin of the polyester family and is used in synthetic fibers; beverage, food and other liquid containers; thermoforming applications (M.Berins, 1991)

2.2 Principle Works

The bottle crusher is cutting the parts from the bottles with a rotary cutting tool with a specified depth and the speed limit, then the two parts separately or it will be truncated. The machine is powered by an electric motor where a shaft has been used for transferring the movement. The principle of operation is as follows.

i. cutter will rotate when the switch is on
ii. Align the bottle into the hopper; the bottle will be crushed when contact with the cutting tool
iii. Scroll will fall in the dustbin space provided

(Yousef Haik, 2010)

2.3 Cutting Tool

There are various types of tool with a variety of functions. The design of cutter blade will influence the size of cuts required. Generally, there are three types of materials used to produce the cutting tool such as High carbon steel, stainless steel and mild Steel. Table below shows two types of cutter blade form (Joseph R.Davis, 1995).

![Types of Cutter Blade](image)

Figure 1: Types of Cutter Blade

2.4 An Electric Motor (AC Motor)

An AC motor is an electric motor driven by an alternating current. It commonly consists of two basic parts, an outside stationary stator having coils supplied with alternating current to produce a rotating...
magnetic field, and an inside rotor attached to the output shaft that is given a torque by the rotating field. There are two main types of AC motors, depending on the type of rotor used. The first type is the induction motor, which runs slightly slower than the supply frequency. The magnetic field on the rotor of this motor is created by an induced current. The second type is the synchronous motor, which does not rely on induction and as a result, can rotate exactly at the supply frequency or a sub-multiple of the supply frequency. The magnetic field on the rotor is either generated by current delivered through slip rings or by a permanent magnet. Other types of motors include eddy current motors, and also AC/DC mechanically commutated machines in which speed is dependent on voltage and winding connection (J.D Edwards, 1991).

2.4 Pulley
A pulley is a wheel on an axle that is designed to support movement of a cable or belt along its circumference. Pulleys are used in a variety of ways to lift loads, apply forces, and to transmit power (Vijay Kumar Jadon, 2010)

2.5 Belt
A belt is a loop of flexible material used to link two or more rotating shafts mechanically. Belts may be used as a source of motion, to transmit power efficiently, or to track relative movement. Belts are looped over pulleys. In a two pulley system, the belt can either drive the pulleys in the same direction, or the belt may be crossed, so that the direction of the shafts is opposite. As a source of motion, a conveyor belt is one application where the belt is adapted to continually carry a load between two points (Vijay Kumar Jadon, 2010).

2.6 Bearing
A bearing is a device to permit constrained relative motion between two parts, typically rotation or linear movement. Bearings may be classified broadly according to the motions they allow and according to their principle of operation as well as by the directions of applied loads they can handle (Vijay Kumar Jadon, 2010).
3.0 METHODS & APPROCHES

This project is designed according to the flow process below:

![Flowchart of design Process](chart1.png)

**Chart 1: Flowchart of design Process**

4.0 FINAL DESIGN

![Isometric View of Crusher Machine](drawing1.png)

**Drawing No. 1: Isometric View of Crusher Machine**
5.0 ANALYSIS (VALUE/COST/BENEFITS, FORECAST)
Some comparisons have been made for the machine in the market. However, the main target user of this machine is for small entrepreneurs or full-time housewives who want to be involved in the recycling industry on a small scale.

5.1 Functional
This machine are very simple to be handled. It is used an AC 1HP motor as a driver for cutter blade. The motor is assembled with the pulleys with purposely for handling a timing belt to control a shaft that are joined at cutter blade, therefore it could be rotate smoothly. These machines have a portable and may be stored wherever right place and do not require much manpower to control.

5.2 Strength
Plastic Bottle Crusher Machine can help consumer from the aspect of energy an time. This machine operated automatically without need consumer energy to generate their product. It also saves a time because this machine has a good efficiency and speed, consumer not to need waiting for long time to complete their product.

5.3 Cost
The manufacturing cost is lower than the market product. It is below than RM2000 per unit.

5.4 Maintenance
Plastic Bottle Crusher Machine doesn’t need a highly maintenance. Cutter blade must be clean every time after used. It just needs to take off from the machine which is connected with the bearing housing on the machine.
5.5 Mechanical safety
The body is mainly made of stainless steel, which can have a durable specification and has a long life time. It was capable to withstand the load until 1 weight tone, and welded by Tungsten Inert Gas (T.I.G).

5.6 Easy to assemble
The installation of machine component is quick and easy, e.g. cutter blade, just loosen a screw to change or cleaning the component.

3.0 CONCLUSIONS
The productivity of this machine has improved where it can crush more plastic bottles at one time. This machine can be operated by one operator only, where it will be able to save time and energy. Size of scroll between 10 to 20 mm is suitable to be transferred for the next cycle. This machine also focused on safety features to users. Design of this machine is compatible with a limited workspace. Hence, it is suitable for commercialization of small and medium industries or full-time housewife who is interested to venture into this field.

4.0 BIBLIOGRAPHY


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