

## Research, design and fabrication of an automatic equipment for recycling plastic scraps from injection molding machines

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**ABSTRACT:** Plastic products play a very important role in daily life as well as in the fields of science and technology. Injection molding is one of the most commonly used methods for making plastic products. This study was carried out for the purpose of recycling scraps generated from the injection molding process. An automatic plastic scrap recycling equipment has been designed and fabricated. Such equipment has been used in conjunction with an industrial injection molding machine in the molding stage. The processes of equipment performance test were also proceeded. Such tests indicate that the equipment has been fabricated to fully satisfy the requirements set forth. Further research directions were also mentioned at the end of this article.

**KEYWORDS:** Plastic products, recycling equipment, injection molding machine, automatic

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### I. INTRODUCTION

Nowaday, plastic is an important material in daily life as well as in production. Products from the plastic industry are very diverse and they are applied in many fields and industries. Typical products from plastic in the consumer sector include packaging of kinds, household items, stationery, toys, etc. In other economic sectors, plastic has also become an important substitute for traditional materials such as construction, electricity, electronics industries, etc. [1]. Ensuring sufficient sources of primary plastic granules for production is a difficult problem for suppliers in the current high demand for plastic from consumers and enterprises [2]. Plastic recycling will be a solution partially overcoming these limitations [3, 4]. In addition, the recycling of plastic materials has a great effect on environmental protection. Protecting the environment is also protecting human health. Energy savings is also another advantage of recycling plastic materials. In particular, recycling waste plastic into new products will take less energy than producing new products [5]. Many types of plastic recycling machines are available on the market such as SY-130 plastic recycling machine [6], GE-PP/PE plastic granules recycling machine [7], and Silmisa Lince 52140S plastic recycling machine [8], RECY-H.-WA-1775 plastic recycling machine [9], etc. However, all of these machines are independently operated, which means they are not connected to a specific injection molding machine. Transporting waste plastic from an injection molding machine to a plastic recycling machine will incur a lot of costs and also affect the protection of environment. A plastic recycling equipment operated simultaneously with the injection molding machine will eliminate such limitation. This is the primary rationale behind this study. A plastic granule recycling equipment operated in parallel with the injection molding machine is the goal to be achieved in this study. To achieve such goal, this study has carried out the following steps sequentially, designing a plastic recycling equipment, fabricating the recycling equipment, and applying the equipment to recycle waste plastic in the injecting molding process. Moreover, an evaluation of the equipment performance was also conducted.

### II. DESIGNING A PLASTIC GRANULE RECYCLING EQUIPMENT

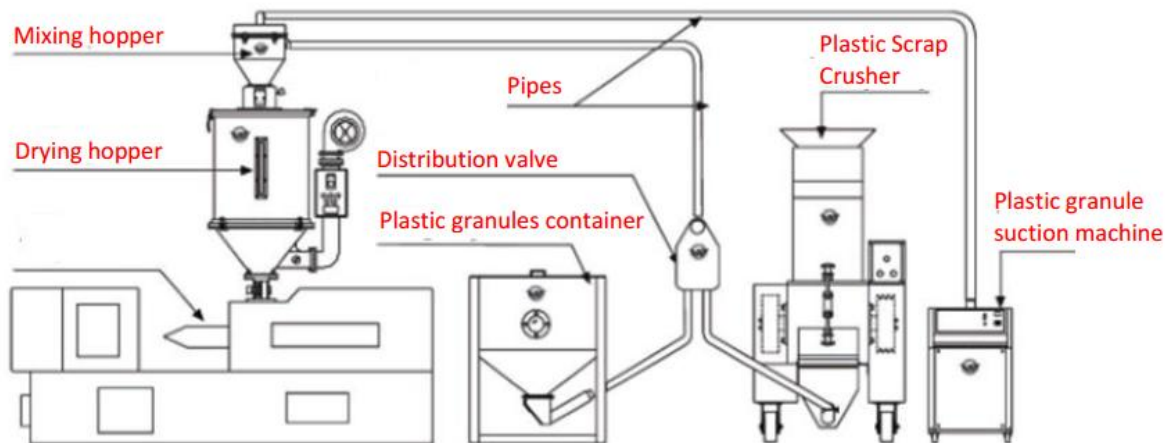
After the waste plastic is recycled, it will be used to make plastic products according to the following stages [10-12].

*Stage 1:* Primary plastic granules and plastic granules after being recycled will be sucked up by a pump and mixed together. The ratio between primary plastic granules and recycled plastic granules is adjusted by the distribution valve.

*Stage 2:* The mixture of plastic granules after mixing will be put into a dryer to remove moisture.

*Stage 3:* The mixture of plastic granules after drying is put into the injection molding machine to create new products.

Thus, the injection molding process can only achieve high performance when plastic recycling is done thoroughly. The design and fabrication of a plastic recycling equipment will determine the efficiency of the plastic processing process. In order for the plastic recycling process to take place in sync with the injection molding process, the specifications of the plastic recycling equipment are required to be consistent with the same of the injection molding machine. Accordingly, the design of a recycling equipment aims to achieve the following basic specifications: capacity from 15 to 25 kg/h, the size of plastic scraps for recycling not exceeding 250 mm, the size of plastic granules after recycling not exceeding 6mm, the equipment's capability to automatically operate or stop according to a preset time, the equipment's capability to adjust the mixing ratio of plastic granules after recycling and primary plastic granules. In order to achieve the synchronization of the productivity of the plastic recycling equipment with the same of the injection molding machine, a diagram showing the connection between these two components has been recommended as shown in Figure 1.

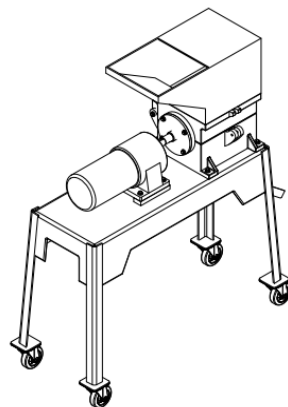


**Fig.1. Connection diagram of the plastic recycling equipment and the injection molding machine**

When the plastic recycling equipment is designed according to the diagram in figure 1, such equipment will operate smoothly according to the stages of the injection molding process [10-12].

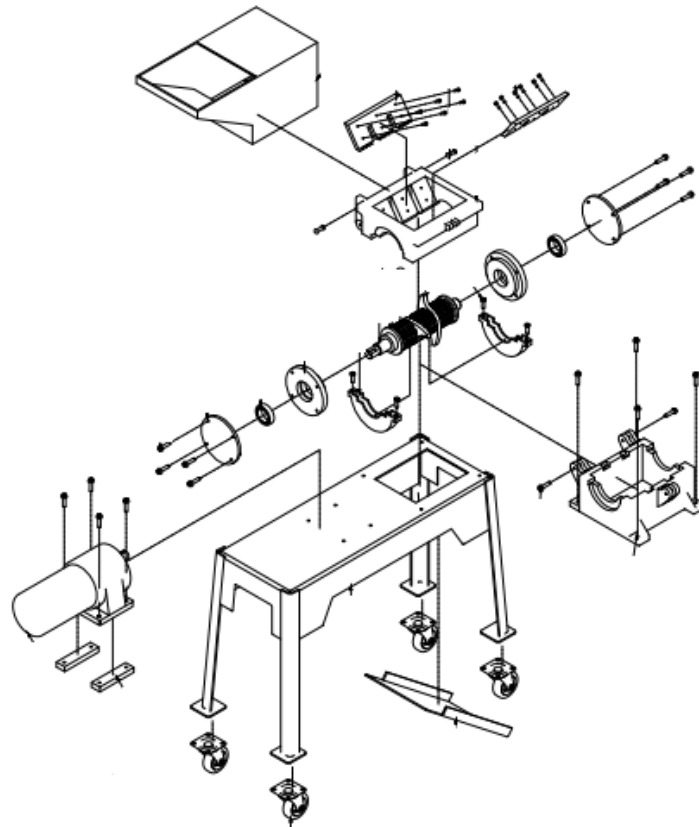
### III. FABRICATING THE PLASTIC RECYCLING EQUIPMENT

On the basis of the schematic diagram regarding the connection between the plastic recycling equipment and the injection molding machine, a 3D model of the plastic recycling device has been designed as shown in Figure 2. This model has been designed based on the model of traditional plastic crushers [13-15].



**Fig. 2. 3D model of the equipment**

After each part of the equipment was fabricated, they were assembled together. The twelve main assembly steps in the assembly process are illustrated in Figure 3.



**Fig. 3. Disintegration model of the equipment**

After finishing the assembly process, a finished product of the equipment was formed as shown in figure 4.



**Fig. 4. Plastic granule recycling equipment**

This equipment is applied in the recycling of plastic granules when connected to SE180EV-A injection molding machine (Sumitomo brand). The combination of the plastic recycling equipment and plastic injection molding machine is indicated in figure 5.



**Fig. 5. The combination between the plastic granule recycling equipment and injection molding machine**

The combination between the plastic granule recycling equipment and the injection molding machine as shown in figure 5 has been used for injection molding of plastic products. An evaluation on the performance of the system was also conducted. The findings show that the system operates stably for a long time and meets all the parameters set out in the design process, which affirms that the plastic recycling equipment has been successfully designed and fabricated, satisfying the set requirements.

#### IV. CONCLUSION

In this study, an automatic plastic granule recycling product on an injection molding machine has been completed in both design and fabrication stages. The equipment has also affirmed its accuracy and stability when applied in production. A study on optimizing the design is a required task in the coming time.

#### ACKNOWLEDGMENT

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