PRECIOUS PLASTIC MONASH UNIVERSITY

Start Here:

Throughout the process of building and running the machines we found various problems which were not accounted for during the design phase. This document describes these issues and the solutions or work-arounds implemented in order to meet operational requirements. General changes were added to the original machine's designs not as solutions to any problems, but as general improvements to better suit the overall aesthetics or to make use of easily obtainable components. In the document, future possible upgrades have been added to help collaboration from other Precious Plastic chapters, so have fun, and let's recycle!

1. Problems Encountered:

1.1 Warping of the honed barrel:

The design originally specified the use of and honed barrel and plunger to ensure a tight seal between the barrel and plunger for prevention of plastic overflow. This design did not take into account the warping and melting as a result of welding. Due to the extremely low tolerance between the plunger and the barrel, excessive warping caused the plunger not being able to manoeuvre through the barrel.

A new plunger was created using a cylindrical rod of slightly smaller diameter, with a honed tip to match the original plunger countersunk and attached to the end to provide a sufficient seal between the barrel and plunger. This decrease of diameter allows for the tip to navigate through the slightly warped barrel. From this, it was learnt that high tolerance components should not be welded, and that if high tolerance is required, the parts should be honed after any manufacturing and welding to account for any deformation.

1.2 Slow response from the thermocouples:

The thermocouples were slow to respond to temperature changes due to the cap the ends. This resulted in the PID controller making the heating bands operate for longer periods than necessary, which increased the risk of burning and degrading the plastic. The solution was to use a thermocouple with a probe end in order to quickly detect and respond to the temperature changes at the heating bands.

1.3 Injection moulds were too heavy for easy attachment to the machine:

During operation, the moulds were found to be too heavy for easy attachment to the nozzle thread. To aid in mould attachment a use of a scissor jack was used for lifting and supporting the moulds whilst applying and during the sue of the moulds. This allowed for additional support to alleviate some of the force on the nozzle tip, rather than relying the holding strength of the nozzle threads.

1.4 Solidification of plastic in nozzle during use:

During operation, it was found that solidification of the plastic at the nozzle tip prevented the injection of the molten plastic into the moulds. As a solution, an additional heating band was added onto the nozzle, to melt the plastic in the dead space between the nozzle tip and the barrel.

1.5 vertical support pulled excessively on table top:

When pulling down on the lever, it was found that the vertical supporting member would pull excessively upon the wooden table it was directly mounted to. A small plate was added to the underside of the table top in order to distribute the forces over a greater area and prevent excessive pulling of the table top during operation.

2. General Changes Implemented:

2.1 Change in barrel cover design and material:

The barrel cover was made from steel mesh and fly screen with heavy duty tape, rather than a solid sheet of perforated metal. This was easier to both manufacture and obtain as most of the materials were readily available in hardware stores.

2.2 Additional thermal breakers added at plunger-lever interface:

Additional wooden panels were added at the plunger-lever interface to break the contact between the two components. This was to prevent any excessive heat transfer from the plunger to the lever over long periods of operation where the plunger remains depressed inside of the barrel.

3. Future Upgrades:

3.1 Frame attachment for additional band heaters:

Vertical supports could be attached to the integration frame which would allow for a band heater to be placed on the hopper and allow for more efficient plastic heating as the plastic would be heated immediately.

3.2 Additional spacers between vertical support and pull rods:

Addition of spacers between the vertical support and pull rods would allow for soother operation. There is currently a mismatch of 5mm between the vertical support member and lever member thickness, which results in some wobble during operation. Adding spacers should smoothen this motion.

3.3 Improved hopper assembly:

Creation of the hopper as a perforated sheet of metal would allow for bending and tack welding instead of welding piece by piece individually.

3.4 Threading of the nozzle outer middle section:

Threading the larger section of the nozzle for better attachment support of larger moulds.

3.5 Use of nylock nuts in area that move repetitively:

If complete disassembly is not required, the use of nylock nuts will prevent the loosening of nuts over time which may result in components (e.g. handle) coming loose during operation. Otherwise, regularly checking and tightening of nuts is recommended before, during and after use of the machine.

3.6 Improved method for attachment of moulds:

The current method for mould attachment is somewhat hazardous as it requires close contact with high temperature elements. A recommended upgrade would be would be to create some sort of funnel with rubber sealing at the mould entrance, and a matching component at the nozzle, which would form a tight seal when sufficiently pushed together by a jack. This would also require an improved method for stabilising the mould. This method would allow for easier and faster attachment and removal of the mould, reducing risk of burns and prolonged contact with heated elements.

3.7 Attachment of vertical support to the frame:

As the vertical support is currently attached to the wooden table top with a small steel plate for reinforcement, it is recommended that the vertical support be attached to a stronger reinforcement such as the integration unit frame itself in future iterations. This would ensure that moulds that require higher injection forces will not pull the vertical support out during operation.