

Simon Fraser University, School of Mechatronic Systems Engineering
MSE 980, Industry 4.0
Fall 2023, Course Project-2

Project Title:

Automation of an Acrylic Bathtub Production Line

Introduction

Acrylic bathtub production relies on mechanized and manual production in many factories. Implementation of automation and deploying robotic technologies can significantly increase production rate and overall efficiency. Please watch the following video showing the different steps acrylic bathtub production.



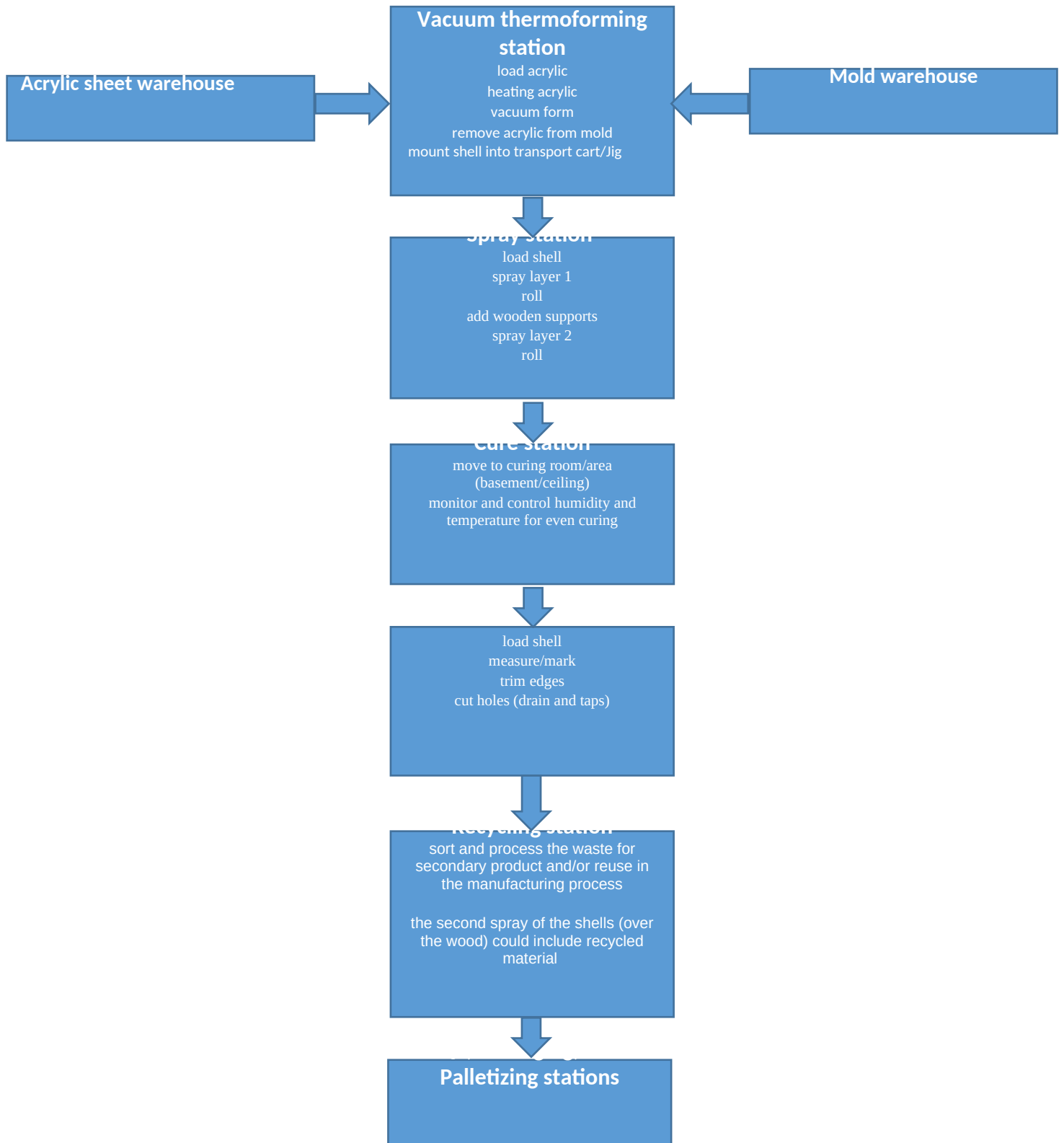
Manual Production of Acrylic Bathtubs

https://www.youtube.com/watch?v=9G_KoX8t6d8&t=742s



The process can be summarized in the following flowchart.

Acrylic Bathtub Production Flowchart



Automated Production of Acrylic Bathtubs

<https://www.youtube.com/watch?v=SCqx8lDQ8L4&t=1s>



Commercially available Robots / Cobots in the market that can be used in acrylic bathtub manufacturing

- List of commercially available Robots/Cobots in the market that can be used in bathtub manufacturing considering the weight and dimensions of different bathtubs available in the market
- Tabular comparison of the available Robots/Cobots in terms of the number of DoFs., workspace, payload, speed, and types of IOs available for peripheral devices, programming, ability to work in harsh environments (spraying), precision, repeatability, price, popularity in the North American/European/ Asian markets (after-sale services)
- Which Robots/Cobot vendor do we recommend for manufacturing
- What features of the robots/Cobots do we need to consider when purchasing and deploying them for the current applications?

Application of Industrial and or Collaborative Robots (Cobots) in Acrylic Bathtub Manufacturing

(Each group should study and review at least 5 applications listed below including how the selected robots should be applied to the following processes, what type of commercially available / special purpose robot and end-effectors need to be used or developed)

- Loading of acrylic sheets into vacuum thermoforming machine, an automated vacuum thermoforming machine can be based on: <https://shzhanshi.en.made-in-china.com/product/xEMrBYdyOJRu/China-Zs-2520-Fully-Automatic-Thick-Sheet-PC-ABS-PVC-PMMA-Acrylic-PS-Plastic-Vacuum-Forming-Machine.html>
- Unloading of acrylic shells from the vacuum thermoforming machine, and delivering the shell to a conveyor system
- An automated warehouse for stocking and retrieving different molds (similar to our SIF-400 facility in Smart Manufacturing Hub)
- Loading / retrieving molds from mold warehouse to the vacuum thermoforming machine
- A spraying and rolling station consisting of one/two robotic arm/s and a positioner for rotating the shell
- Loading/unloading robot for the trimming station, the CNC trimming machine can be based on: <https://dmscncrouters.com/product-lines/dms-essentials-5-axis/#> . Please note that for selecting the CNC router, you need to consider the overall dimensions of the bathtubs available in the market. The CNC router trims the shells and creates the holes for drains and taps
- Robotic visual inspection of bathtubs for quality control
- Loading the finished bathtubs into boxes
- Automatic Palletizing of the boxes

Benefits of Robots/Cobots in Automated Manufacturing of Acrylic Bathtubs

- How Robots/Cobots increases the efficiency, throughput, and productivity, and safety of the above procedures in bathtub manufacturing
- What is the driving force behind using Robots/Cobots in bathtub manufacturing?
- How we can calculate the Return on Investment (ROI) when deploying Robots/Cobots in such manufacturing lines

Students should prepare a PowerPoint presentation using the following resources

- Websites of vendors (Robots/Cobots, grippers, end-effector tools, vision sensors, etc.)
- Website of vendors (partner section), partners provide complementary technologies to Robots/Cobots such as vision systems, special grippers, etc.
- White papers from vendor websites (Robots/Cobots, grippers, end-effector tools, vision sensors, etc.)
- Datasheets, catalogs, and brochures of the above elements
- YouTube channels and videos
- Webinars
- Scientific papers (Journal/conference papers) from 2017 to present

Project presentation

- 1- Projects can be done in a group of two or a maximum of three students.
- 2- The project and presentation due date is Nov. 29 and Dec. 04.
- 3- Each group should submit a PowerPoint presentation.
- 4- Each group should study and review 5 applications listed above.
- 5- Each presentation should be done in 15 min.
- 6- Each presentation should cover 20 slides.