TMP Manufacturing, Incorporated – Long term response of refrigeration panels

Overview
Vice President of TMP Manufacturing, Incorporated, Garry Brannon, wants to know the lifetime of the polyurethane foam refrigeration panels that TMP manufactures. To determine the lifetime of the panels, the team needed to create a mathematical model to simulate aging. The mathematical model consists of a heat transfer and mass diffusion rate analysis.

Objectives
The team’s main objective was to show how polyurethane foam degrades over time. To accomplish this task, we tested TMP’s polyurethane foam at various temperatures to induce failure and created several theoretical models to compare with the tested data.

Approach
- Brainstormed what the problem statement was asking in order to gather customer needs
- Created an Analytical Hierarchy Process (AHP) matrix to determine primary needs
- Performed a literature review of past experiments to see what has already been completed
- Reviewed patents to understand how polyurethane foam is sprayed, inventions, and characteristics
- Sought out a testing facility to test for thermal conductivity and heat flux over time, due to lack of equipment
- The testing facility stopped communication, so the team resorted to a home testing method consisting of a hot plate, several thermocouples, a heat flux sensor, and respective monitoring equipment
- Created theoretical heat transfer and diffusion analyses
- Performed the home testing but results were inconclusive
- The theoretical analyses were very similar to research found during the literature review
- The analyses of polyurethane foam were created and plotted using Microsoft Excel and compared to graphs and research found in the literature review to ensure accuracy

Outcomes
The team confidently determine that TMP Manufacturing, Inc.’s refrigeration panels become more thermally conductive over time and should have a minimum lifetime of 30 years assuming negligible mechanical forces.
- The project accurately projects the lifetime of TMP’s refrigeration panels
- The higher the temperature of the environment, the lower the lifetime