Grant Recipient Report

Steel Curriculum Development Grant

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The overall objective for this project is to upgrade several parts of the pilot-scale metal/steel processing facility to reach Industry 4.0 standards. This means upgrading different forms of data collection and processing so that the systems work efficiently and reliably. The project also has a focus on centralizing all the data for ease of access and functionality.

At Michigan Tech there is a fully operational metal processing facility (foundry) on campus. This facility has many outdated features and does not meet the data acquisition and processing standards of Industry 4.0. To help the foundry reach these standards, a team was created through the Advanced Metalworks Enterprise (AME) to go in and update several systems and allow the foundry to have more up-to-date equipment which should allow for quicker and more reliable data acquisition and processing. It also should help with ease of access and centralization of data. This team met on a weekly basis to go over what needed to be done and progressed throughout the year on several different tasks in the project.

The focus of the spring semester was to finish several of the tasks started in previous semesters. These devices were put in and were close to functional but before the year ended, the devices were never up and running. The goal for this year of the project was to round up all the loose ends from previous semesters. This entailed setting up all the data collection methods and creating the internal connection system. In the end, new data collection was implemented with some steps left to fully complete the setup due to some issues with previously purchased devices. The internet setup was completed, and the central data storage was set up and is functional and ready for interaction. Standard operating procedures were created for several of the devices so staff and students know how to use each of the devices.

In addition to the completed tasks for this project, the following topics were reviewed in the corresponding courses.

- MET2153 – Machine Tool Fundamentals and Applications: The influence of steel alloy and heat treatment on the metal removal process. Surface speeds and feed rates are covered and demonstrated in corresponding lectures and laboratory experiments.
- MET 3242 – Machine Design I: Specifying a steel alloy for fatigue failure. Four lectures were dedicated to the topic of fatigue failure. Low-cycle fatigue, high-cycle fatigue, and endurance limits were covered, and the influence materials play in defining failure. The manufacturing of steel was covered to illustrate how steel is produced and how Industry 4.0 is used in the production of steel, so consistent material properties can be achieved.
- MET 3451 – Machine Design II: Steel selection and heat treating in gear design and spring design. Five lectures were dedicated to the topic of spur and helical gear design, bending stress, and contact stress. Material selection was covered and the importance of heat treatment to address high contact stresses and good wear properties in gear teeth. Three lectures were dedicated to material properties in helical coil spring design. Steel production was reintroduced and the importance of quality control in the manufacture of steel alloys and what variability is allowable in a production setting. The Industry 4.0 project was reviewed to illustrate the direct alignment with quality control so consistent material properties can be achieved during the steel manufacturing process. ✦