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STEEL CURRICULUM DEVELOPMENT GRANT

The objectives set for the 2019–2020 academic year included conducting a review of ironmaking and steelmaking operations with regard to sustainability; conducting plant tours, which were delayed due to stay-at-home orders related to the coronavirus pandemic; and the design of a small-scale electric arc furnace.

Due to the COVID-19 restrictions, Michigan Technological University has been completely closed down since mid-March. This has slowed progress on the goals for the first year of the Curriculum Development Grant.

The first objective of the grant was to conduct a review of ironmaking and steelmaking operations to determine where advances are being made in improving the sustainability of the industry. This work is being carried out with the assistance of an M.S. graduate student. The review ranges from evolutionary improvements in conventional technologies, through carbon-free processes such as both low-temperature and high-temperature electrolytic ironmaking. Once the review is completed, it will be incorporated into the curriculum for the course CM4740 – Hydrometallurgy/Pyrometallurgy, and will be submitted for peer review and publication.

The second objective, to plan trips to an appropriate advanced steelmaking operation to gain firsthand knowledge of the facility for use in courses, has been delayed due to the stay-at-home orders.

A team of undergraduate students has been designing a small-scale electric arc furnace, suitable for demonstrations that will be used in CM4740. The purpose of this unit is to give the students a direct hands-on example of what is

involved in electric arc melting. In particular, they will gain experience with proper safety measures for working with electric arcs and molten metal, an appreciation for the energy levels needed for melting iron and steel, and the opportunity to see directly how slags and furnace dusts are produced. For a power source, the student team has selected a basic welding power supply that can supply either AC current up to 225 amps, or DC current up to 125 amps. In combination with graphite electrodes and a suitable crucible, this will be suitable for melting samples of a few hundred grams. The option of AC or DC current will allow the choice of either an AC arc for demonstrating the melting of metallic scrap, or a DC arc which can potentially be used for demonstrating an oxide reduction furnace. The students have also selected appropriate safety equipment for operating this unit, and designed an enclosure to provide shielding from the UV light from the electric arc, and contain any spills from the actual melting unit. The entire unit will fit inside of a fume hood, so that the emissions can be contained and handled appropriately.