Evaluating and Mitigating Static Electricity in Oil and Gas Fluid Delivery and Storage Systems

Overview
In the oil and gas industry, volatile fluids are pumped through systems where there is a potential for static electricity to build up. When this static electricity builds up to create a large change differential there is potential for sparks and explosions to occur. In order to mitigate the building up of static electricity it is industry standard to use a procedure of bonding and grounding before any sort of pumping is permitted. The Marathon Petroleum Company challenged the Penn State team to create a system that would model this vacuum truck fluid movement system and document voltage and resistance values across the system as different fluids were being pumped through the system. In order to ensure that no harm would come to the team only nonvolatile fluids were to be used during all testing.

Objectives
The objective of this project was to simulate the vacuum truck and oil tank system and then run the system with the use of bonding and grounding cables and then to repeat the procedures without bonding and grounding procedures. In each set of testing different voltages, capacitances, and resistances were to be collected in order to determine the rates at which static charge builds up as well as the effectiveness of the bonding and grounding systems used today. The Marathon Petroleum Company hopes that the outcomes of this project will help them answer many of the questions that are brought up in their work every day and make the workplace safer for many of their employees as well as to teach their employees about the importance of following procedure for their own safety.

Approach
- Determined the needs of the customer during an onsite visit at the Midland, PA Marathon Petroleum site.
- Industry standards that were provided by Marathon Petroleum were reviewed by the team and important sections were noted during all development and testing.
- Different concepts were developed but after extensive comparison the best design determined by the team was chosen for the testing model.
- A stainless steel, 12 gallon capacity, 6.5 peak horse power, wet-to-dry shop vacuum was chosen for the model because it fit all of the customer’s desires.
- The model was constructed using as much metal and secure connections as possible because this would give the team the best possible testing outcomes.
- Testing was videotaped and then recorded into excel files to allow for different formatting based upon desired outcomes.

Outcomes
- Results show that bonding and grounding result in an overall voltage differential of 0 volts across the system.
- When fluids with higher conductivity are run through the system, the overall voltage differential across the system is lower.
- Determining the capacitance of the overall system is nearly impossible but it is quite probable that the voltage differentials created across the system would be enough to translate to an explosion in the real life system.
- Safety precautions currently being taken by the Marathon Petroleum Company have ensured the safety of their workers.