John Deere Horicon Works

April 13, 2017

Dear Chemical Engineering Team,

John Deere Horicon Works is the largest manufacturer in Dodge County. About 40% of the Horicon factory's production is for with Gators. Utility gators are purchased for farm-use, hunting, recreation, and for military operations. The rest of the production is comprised of lawnmowers. We pride ourselves on being efficient and productive so we can reduce our costs and compete with China and Mexico.

Our recent raw steel shipment that will be used for lawn mower decks has light rust on it. We cannot use it as is. The rust needs to be chemically removed. We need your Chemical Engineering Team to develop a cost-effective industrial process that can remove this rust chemically

Information:
1. The raw steel for the lawnmower decks are 3' x 4' in size
2. Waste process water leaving the John Deere Plant needs to meet EPA Guidelines (pH 5-9 and below 120 ℉).
3. John Deere orders chemicals through Grainger (bulk) or Fisher Scientific https://www.grainger.com/ https://www.fishersci.com/us/en/products/IC6JWG15/chemicals.html
4. John Deere orders supplies (tanks and piping) from McMaster Carr online https://www.mcmaster.com/
5. Cole Parmer's website has a database of chemical compatibility https://www.coleparmer.com/chemical-resistance

Your proposal needs the following elements:

Written Proposal

1. Description of how you will remove the rust
2. Description of how you will treat the waste process water to meet EPA guidelines
3. Chemicals used to remove rust and treat the waste process water
    a. Rationale for use
    b. Amount needed
    c. Cost
    d. Compatibility score for the materials (tanks/pipes) it comes in contact with
    e. pH
4. Tanks and pipes to transport or hold chemicals or metal
    a. What substance is it made out of?
    b. Size or length
    c. Cost
    d. Compatibility score for the materials it comes in contact with

Drawing

1. Schematic diagram of the industrial process used
    a. Labeled chemicals, amount, pH, and compatibility score
    b. Labeled parts (tanks, pipes), what it is made out of, size/length
    c. Shows inlet and outlet for chemicals or wastewater
    d. Show inlet and outlet for raw steel piece that needs rust removed

Balance Spreadsheet

1. Outline costs
    a. Chemicals (taking into account amount)
    b. Tanks, pipes, etc. (taking into account size/length)
2. The estimated cost of project

		Below Mastery	**Mastery**	**Exceptional (EC)**
Written	**Rust Removal**	Process described will not remove rust **1 pt**	Describes a process (chemical) that will remove rust **2 pts**	Description meets mastery and describes **why** the rust is removed chemically **3 pts**
	EPA guidelines	One EPA guideline met with wastewater **1 pt**	Two EPA guidelines met with wastewater **2 pts**	Meets mastery and describes **why** pH changes chemically **3pts**
	Chemicals	Only one chemical described (rationale, amount, cost, compat., pH) **5 pts**	Two chemicals described (rationale, amount, cost, compatibility, pH) **10 pts**	Meets mastery and shows **calculations** for amounts needed **12 pts**
	Tanks/ Pipes	Only one material described (ID, size/length, cost, compatibility) **3 pts**	Two or more materials described (ID, size/length, cost, compatibility) **6 pts**	Meets mastery and includes materials beyond pipes and tanks that are necessary **7 pts**
Balance Sheet	**Prices**	A few prices and amounts in a spreadsheet **2 pts**	All prices and amounts in a spreadsheet **4 pts**	Meets mastery and goes above and beyond to calculate find prices **5 pts**
	Total cost	Total cost not reasonable **1 pt**	Total cost takes into account reasonable amounts **2 pts**	Meets mastery and goes above and beyond to calculate costs **3 pts**
Diagram	**Label Chemicals**	Basic labeling **2 pts**	Labels with amount, pH, compatibility **4 pts**	Meets mastery and professionally done **5 pts**
	Label Tanks/ Pipes	Basic labeling **2 pts**	Labels with size/length, material **4 pts**	Meets mastery and professionally done **5 pts**
	Inlet/ Outlet Chemicals	One present **1 pt**	Both present **2 pts**	Meets mastery and goes above and beyond **3pts**
	Inlet/ Outlet Metal	One present **1 pt**	Both present **2 pts**	Meets mastery and goes above and beyond **3pts**