HUSKY INDUSTRIAL CHEMICAL CONSULTING 2019

Boeing: Chemical Bath Life Forecast

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BOEING

Problem Statement

Boeing does not currently have any way to decide when to optimally dispose their chemical tanks. Improper tank disposal is detrimental towards their whole etching process.

An unplanned tank disposal can lead to:

- A waste of etch chemicals which are not only costly to obtain but also costly to dispose and harmful to the environment.
- A disturbance to Boeing's processing schedule which leads to overtime work to remain on track. Overtime work leads to higher labor costs and mental health risks of the operators.

Goal Statement

Create a forecasting system through Excel to predict the optimal time to recharge the chemical bath to account for dynamics in production by utilizing data analysis to allow for two weeks advance notice.

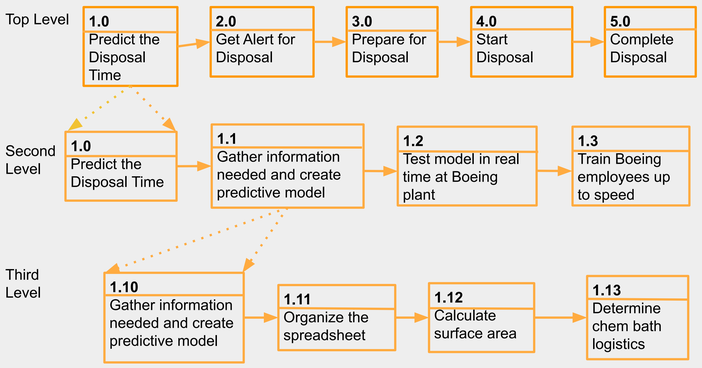
To create forecasting model that will alert the employees of the optimal time to recharge the chemical baths.

To provide Boeing with a method of tracking the number of parts run through a tank each week.

Database Description:

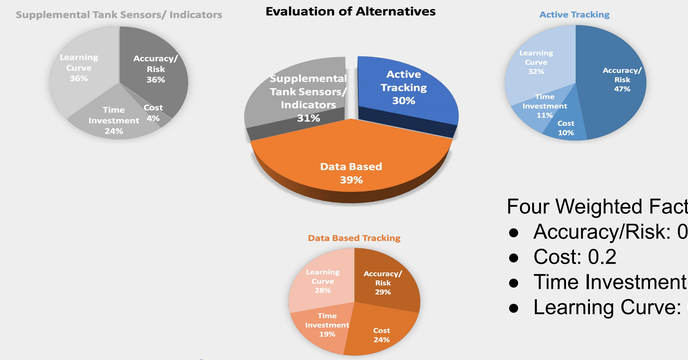
- Two historical data from etch tank R8, about 40,000 items
- Multilevel Built of Material (BOM) including: item number, length, material type, diameter, wall thickness
- The tank chemical sample testing about two to three days a week.

Process Flow Map:



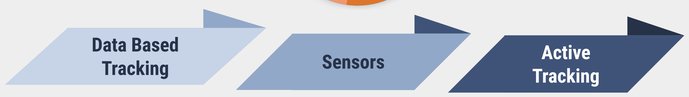
Part Tracking Methodology

Risk Analysis for Three Alternatives



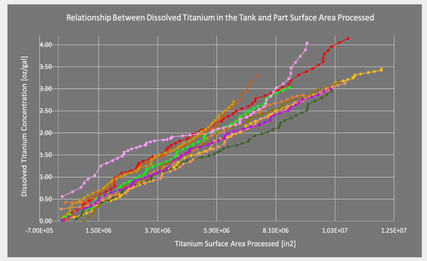
Four Weighted Factor:

- Accuracy/Risk: 0.3
- Cost: 0.2
- Time Investment: 0.2
- Learning Curve: 0.3



Chemical Relationships Finding:

- The approximate etch factor based on all the sets involved yields a value of 3.3 oz/ gal Ti / in^2
- The graph also verifies that there is a relatively linear relationship between the dissolved titanium concentration and the surface area of titanium parts processed



Model Design & Creation

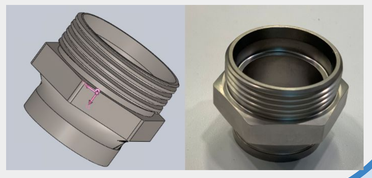
The model we created is a disposal prediction tool that provides an appropriate disposal date based on a part schedule added by the user.

Variables Example:

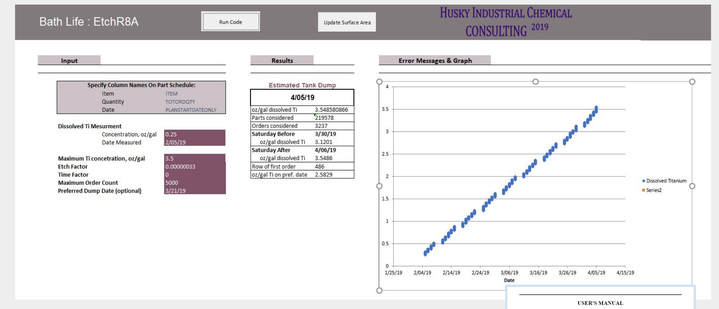
Current Conditions	The most recent concentration of dissolved Ti. (with the unit of oz/gal) and the date it was measured at.
Maximum Ti concentration, oz/gal	The maximum allowable concentration of dissolved Ti in the etching tank before it gets disposed that the users can set according to their need. (with the unit of oz/gal) and is currently defaulted at 3.5 oz/gal
Etch Factor	The default etch factor is set to 0.00000033. This is based on our analysis of historical data. Users can change the number according to their needs.
Time Factor	The time factor is the change in dissolved titanium over time regardless of part processing. This factor is defaulted 0, as we were unable to correlate time and dissolved titanium concentration. It could be changed according to the need of user.
Maximum Order Count	This number represents the maximum order count in the code to prevent the large order number which might cause the overflow.
Preferred Disposal Date	The date input here allows the user to see the predicted dissolved Ti concentration on this date.

Surface Area CAD Fittings:

Fittings are taken into account to make the model more accurate, all fitting types are modelled through CAD to obtain their respective surface area information:



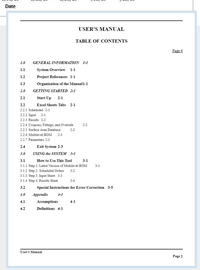
Interface Design



User's Manual

A 19-page long user's manual includes:

- Steps to follow
- Definition of the names
- Assumption List
- Explanation of the Error Messages



Impact & Economic Analysis

Labor Cost

An unplanned tank disposal typically requires 2 overtime shifts to keep up with production schedule. Each unplanned tank disposal leads to $2777 spent on overtime labor costs. If every tank disposal is unplanned throughout a year, our model could potentially avoid $16,082 /year.

Materials Cost

A premature disposal results in wasted chemicals. The average premature disposal on average occurs when the dissolved titanium is at 88% of its max. value, each tank disposal will cost Boeing $304, this translates to $1770 /year.

$ XX,000/yr

Environmental Impact

On average, 12% of the 1460 gallon bath goes unused, and is sent directly to the waste facility. Better use of these chemicals reduces environmental impact.

Reliability

By providing a 2 weeks advance notice for a disposal date, the consistency of disposals is improved and thus reduces the likelihood of unwanted unplanned disposals, increasing the overall reliability of the tank's operation.

Recommendation & Future Improvement

- Implement the forecast tool into manufacturing process documentation
- Update the database frequently to maintain forecast accuracy
- Barcode scanners for better part tracking accuracy and account for flash etching
- Use this model as a leverage for chemical tanks other than etch R8A

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