

OPTIMAL PREVENTIVE MAINTENANCE SCHEDULING IN PROCESS PLANTS

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EXECUTIVE SUMMARY

This work expands upon the previous work of Nguyen et al. which developed a new methodology for assessing the effectiveness of preventative maintenance scheduling guidelines on a small chemical processing plant. Here, the model is applied to larger processing plant – the FCC unit of a large refinery – and expanded to consider risk analysis. Effectively scheduled preventative maintenance has the potential to reduce production losses and maintenance costs, making it a matter worthy of great study and evaluation by process companies.

Using a time horizon of ten years, Monte Carlo simulations are used to determine the optimal labor force for each process. Setting labor constant, Monte Carlo simulations were then used to evaluate preventative maintenance (PM) intervals for equipment by providing cost probabilities and average total cost. Optimization by setting different PM intervals for each equipment group is studied by Monte Carlo on the smaller process, and by genetic algorithm on the FCC. A study of risk is also considered by application of a fitness function to incorporate “value at risk” in addition to average total cost in obtaining optimal solutions.

Monte Carlo simulations show a noted improvement in PM scheduling when using different maintenance intervals for unique groups of equipment. The evaluation of risk, however, failed to yield any beneficial results. Changes in PM scheduling resulted in shifts to average total cost with no substantial change to value at risk. This resulted in a fitness function mirroring results based solely on average total cost. This is due to the cost-probability curve shifting to higher and lower values without any real change to distribution. Finally, the genetic algorithm proved successful in proposing preventative maintenance scheduling solutions though further work is required to obtain greater convergence to algorithm results.

In conclusion, an evaluation of risk in maintenance costs proved unbeneficial, leading to PM solutions being evaluated solely on the basis of average total cost. Monte Carlo simulations are useful for optimizing individual components, though labor-intensive and inefficient for considering large processes with numerous variables. For such larger applications, genetic algorithms – while time consuming to run – are able to provide consistently optimal results, though total convergence has not yet been achieved, leaving room for future study and analysis.