CJ BIO AMERICA

FORT DODGE

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SCHOOL: Iowa State University

MAJOR: Chemical Engineering

COMPANY PROFILE:

CJ Biotechnologies is a global company with 11 facilities in six countries. The company produces food grade and feed grade bioproducts for human and animal consumption. Two feed grade essential amino acids, lysine and threonine, are manufactured at the CJ Bio America refinery in Fort Dodge, Iowa, for use in swine and poultry diets. This facility operates continuously 24 hours per day, seven days per week with approximately 250 employees.

PROJECT BACKGROUND

Lysine is produced at the Fort Dodge facility using an advanced microbial fermentation and refinery process. It is critical to CJ Bio America to ensure that it does not experience lysine product loss in the production process. To closely monitor production integrity and avoid leaks, the company performs regular sampling and testing of its high solution broth (HSB) throughout the day. Currently, a high-performance liquid chromatography (HPLC) machine is used to conduct this testing. An HPLC test takes 90 minutes to run, so if the results demonstrate a loss of lysine product, significant operations time is lost before operators become aware of it.

INCENTIVES TO CHANGE

Environmental stewardship is a corporate priority for CJ Bio America with an aim to be carbon neutral by 2050. To accomplish this mission, it seeks to implement continuous improvement strategies in all aspects of its operations to meet midterm and long-term environmental goals.

The HPLC test is highly effective but generates a waste that is classified as hazardous and requires special handling and costly disposal. In assessing hazardous waste generation at the Fort Dodge refinery, CJ Bio sought to identify a viable testing option with a reduced environmental impact.

RESULTS

Replace HPLC with a TOC Analyzer: A total organic carbon (TOC) analyzer with a 20-minute run time could be a viable option to monitor for lysine loss. The shorter turnaround time represents a gain of 70 minutes of labor time for each test run and also represents 70 minutes of product recovery value in the case of a loss. The intern was tasked with comparing the quality and accuracy of the TOC results with the HPLC outcomes and adjusting set-points to determine the viability of the TOC as an alternative testing method. To successfully compare the lysine testing performance of the TOC with the HPLC, a strict sampling and testing protocol was followed. Comparison testing was undertaken in three phases.

Phase I: The intern spent the first two weeks of the project in the quality control lab, gaining training and experience with the HPLC. By becoming familiar with the equipment manuals and standard operation procedures (SOPs) for the machine, the intern acquired an understanding of how the testing happens within the machine. Additional training and shadowing of lab employees further prepared the intern for collecting, prepping, and testing the HSB samples from the refinery.

Phase II: The intern went through a similar process to become familiar with the operation and testing procedures of the TOC analyzer. From there, the intern took daily samples prepared by quality control staff and conducted tests with the TOC analyzer. Results were used to adjust the settings of the TOC analyzer until it was producing test results that were consistent with the HPLC.

Phase III: In phase III, each of the daily HSB samples were tested, first on the HPLC and then on the TOC analyzer. The data from both tests was then logged onto a spreadsheet to generate a correlation equation. Increasing the data set over time, the goal of the correlation equation was to translate the test result data from the TOC analyzer into a comparable output with the HPLC to verify accuracy and consistency of the potential alternative testing method.

Results: The intern tested more than 350 samples on both the HPLC and the TOC over the course of the project. The results of the testing thus far have yielded a correlation equation that is able to predict the HPLC test reading from the TOC test result with a promising degree of accuracy (good R2 value). Additional testing points will be needed to further increase the R2 value and refine the correlation equation. CJ Bio staff will continue testing until they reach the desired R2 value, which will provide the verification needed to seek approval for adopting the alternative testing process.

When the TOC testing process is fully implemented for lysine testing by CJ Bio, the impacts to the plant's hazardous waste generation and labor savings would be significant. In addition to reducing hazardous waste generated at the plant, the amount of time needed to run sampling tests for lysine could be reduced considerably.

ENVIRONMENTAL AND ECONOMIC SAVINGS TABLE

PROJECT	ANNUAL COST SAVINGS	ANNUAL ENVIRONMENTAL RESULTS	STATUS
REPLACE HPLC WITH A TOC ANALYZER	$57,763	1 lb. octane sulfonic acid 40 lbs. potassium phosphate monobasic 0.98 lbs. phosphoric acid 25.15 lbs. acetonitrile 25.34 lbs. methanol 1 lb potassium hydroxide 1 lb. boric acid 1 lb. phthaldialdehyde 19.68 lbs. 2-mercaptoethanol 1 lb. brij 35	RECOMMENDED