Linwood Mining and Minerals

COMPANY BACKGROUND



Linwood Mining and Minerals Corporation is one of the leading companies in the limestone industry. The company traces its roots back to 1944 and today ranks as one of the largest underground limestone mining operations in the United States. Linwood also manufactures chemical lime and calcium carbonate in process kilns and milling operations that run 24 hours a day, 7 days a week, 365 days a year. To provide raw material for the chemical lime and calcium carbonate processes, the Linwood mine operates 12 months a year. The 1000-acre facility (quarry and lime plant) is located on the southwest side of Davenport and has 103 full-time employees.



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PROJECT BACKGROUND

Some of the processed limestone from the quarry operation serves as raw material for the chemical lime and calcium carbonate operation. In the manufacture of chemical lime, the raw material is processed in rotary kilns where it is calcinated at approximately 3000° F. The kilns are fired with a combination of coal, coke, natural gas and methane gas from a nearby landfill. Two of the four kilns use exhaust gases to reduce the moisture content of the raw material. The site uses 25,000 to 30,000 tons of coal, 26,000 to 35,000 tons of coke, 1,000 MCF of natural gas and 300,000 MCF of landfill gas annually.

High-volume consumption of solid fuel (coal and coke) and gas (natural and methane gas) with raw calculations for fuel blending opened a pathway for this project to improve the thermal efficiency of fuels at Linwood Mining and Minerals. Furthermore, the presence of unburned fuel in the output product and various associated fuel constraints magnified the need for an economical optimized blend of fuel.

INCENTIVES TO CHANGE

Linwood is seeking to find the most economical fuel mix to fire kilns. Due to high volume and variation in fuel properties (BTU values), there is tremendous potential for cost and energy savings by optimizing the existing blending ratios of fuels under various application constraints.

RESULTS

The project was conducted in two stages. In the first stage, an unconstrained mathematical model for fuel mixture optimization was developed, programmed and tested in MATLAB. In the second stage, a realistic model was developed by incorporating constraints associated with each fuel type: coal, coke, landfill gas, coke and coal mixture, and coke and landfill gas mixture. Software named 'Fuel Efficiency Optimizer' was developed in Visual C++ by using the constraint fuel optimization model as a working engine and OpenGL as an application programming interface.



The 'Fuel Efficiency Optimizer' enables the user to control the mixed fuel efficiency and selection criteria by executing a customized fuel analysis. The output is displayed in graphic and text form with an ascending order of cost. The user can select the most economical fuel blend under given fuel properties, mixing ratios and active constraints.

Initial calculations show that approximately $830,000 could have been saved over the past three years if fuel types and blending ratios recommended by the 'Fuel Efficiency Optimizer' were used. With a projected production of 500 tons of lime per day, annual savings of $250,000 is anticipated for the year 2007.

Project	Annual Cost Savings	Environmental Results	Status
FUEL EFFICIENCY	$250,000	NO CHANGE IN SULFUR DIOXIDE EMISSIONS, LANDFILL GAS RECOVERY	IN PROGRESS