HOW SIMULATION AND ANIMATION MODEL OF AN AGGREGATE MINE ASSISTS ENGINEERS IN THE OPERATION OF HAULAGE SYSTEMS

E. Tarshizi, Univ. of Nevada Reno, Reno, NV J. Sturgul, Univ. of Adelaide, Adelaide, SA D. Taylor, Univ. of Nevada Reno, Reno, NV

ABSTRACT

Research was conducted to develop a simulation and animation model for an aggregate (sand and gravel) mine operation. This model can assist the mine engineers to investigate and consider the various options of haulage systems which are critical for the mine operation productivity. Discrete-event system simulation studies can be used for the typical haulage issues that mining engineers are often faced with: using truck fleet haulage, conveyor belts, or a combination of both. The simulation has identified some strengths and weaknesses in the current loading and hauling fleet of the mine, and has resulted in some suggestions for improving the system. The simulation includes animation of the operation. Animation is needed to enhance the benefit of any mine simulation model. By combining the visual power of animation with a mine simulation, a complete picture of the mine system is obtained and displayed. The mine is modeled and animated using GPSS/H[®] and PROOF Professional[®], both of which have shown great applicability in discrete mining simulation projects.

INTRODUCTION

A sand and gravel mining operation was proposed for the simulation study of different mine haulage systems. This mine simulation model compared truck/loader and conveyor belt systems. The mining project is situated on 660 acres in Shasta County of California. At this site the mining, reclamation, and processing adhere to the latest standards of Surface Mining and Reclamation Act, federal, state, and local laws. The mining operation will be carried out in three phases, each phase having the duration of 8-10 years.

It is estimated the project will be complete by 2035 with the allowance of 10 years for all reclamation activities to be finalized. This life of mine will vary due to any number of factors, such as the quality of aggregate and the demand of aggregate in this region. A geotechnical report was prepared for this project and the results were as follows: 0-3 meters deep clay, silt, sand and topsoil; the aggregate layer is 3 to 7.6 meters below this which consists of sand to 15cm cobbles. Overburden will be used for mining, backfilling, flood control, and reclamation. Some aggregate will be used for project infrastructure, such as on-site roads (EIP Associates, 2004).

SAND & GRAVEL MINING OPERATION OVERVIEW

This mining operation will have three phases with a life of mine estimated to be 24 to 29 years. Dealing with overburden at each phase will be different. Overburden will be used to build the proposed levee, a spur dike along the boundary, and for backfilling each phase for reclamation. The aggregate mine will have no impact on surrounding properties. For this mining project, water will be pumped to the site and it will have an on-site processing plant. The sand and gravel mine will comply and carryout the necessary actions for the following: dust and noise control, natural resources protection, visual resources and project noise, terrestrial biological resources, and public safety (EIP Associates, 2004). Equipment for this project will include a water truck, front-end loaders, a hydraulic excavator, offhighway trucks, self-loading scrapers, track dozer, and a 750 kilowatt diesel generator. The haulage systems should carry mined materials to the process and storage area from different mine planned phases (EIP Associates, 2004).

BELT CONVEYORS VS. HAUL TRUCKS IN MINING

This comparison analysis between haul trucks and conveyors will be general and can be applied to any type of mine - small or large, and underground or surface. In any of these systems, the basis of the mine design will be determined by site specific parameters. There are advantages and disadvantages for both truck hauling and conveyor belt systems when transporting materials. A few points that will be compared are topography, economic analysis, and environmental impact. In the initial mine design phase the topography will determine existing surface limitations when looking at the transport of materials. In the economic analysis for both of these methods involve capital cost, operating cost, maintenance cost, and the life expectancy of the equipment. From the start, both will have high initial costs; therefore, having a well-organized mine plan will determine which method(s) are most suitable throughout the life of the mine operation. In the wake of environmentally friendly procedures and equipment, mining operations look at the impact these items have towards the environment, for instance dust, emissions, and noise.

A comparison of Haul Truck systems and Conveyor belt systems is as follows: