IMPLEMENTATION ENGINEERS®

CASE STUDY

Recovery Improvement

Gold Mining and Processing – Blending Optimization for Mill Throughput and Recovery

An Implementation Engineers Engagement

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Seasonal conditions pose production challenges

Historically, ore feed to the mill was exclusively from stockpiles four months of the year. During the period, net recovery averaged 57.5 percent, throughput 671 tons per operating hour and uptime per day was 96 percent. The project charter is shown below in Figure 1.

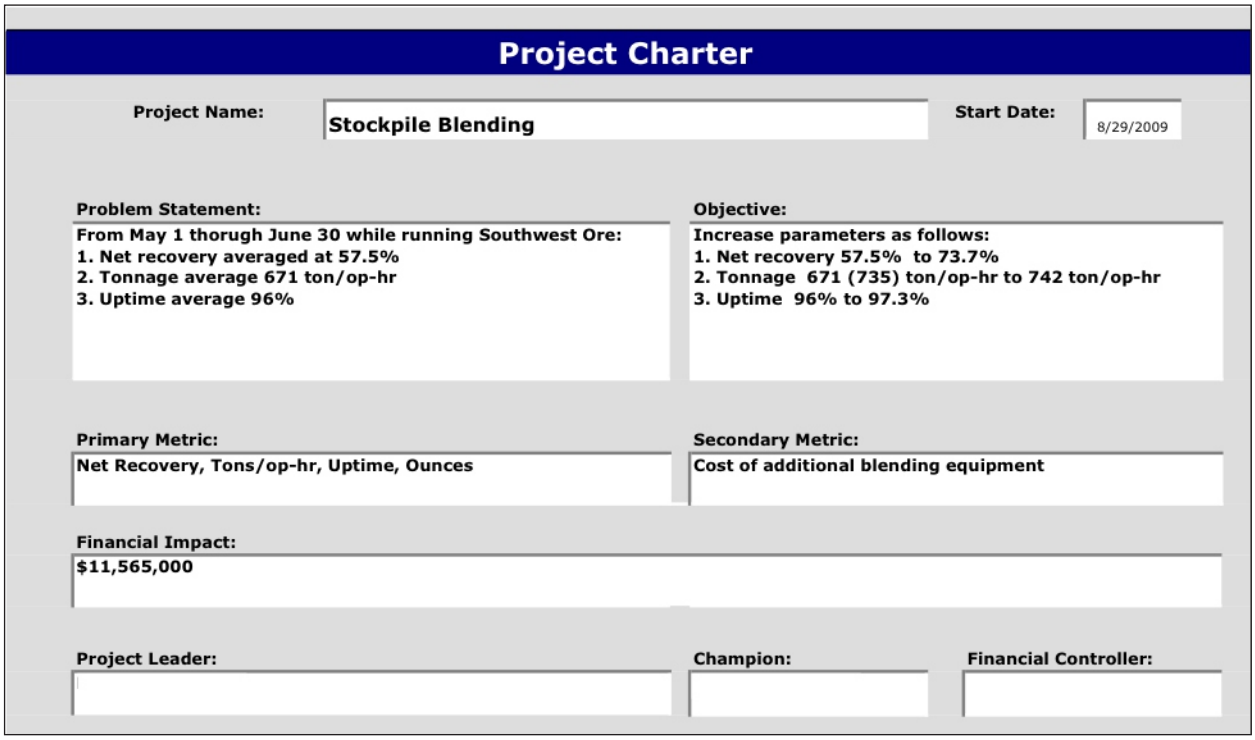

Figure 1 – Blending Optimization

Recovery for the baseline period varied significantly from as low as 40 percent to as high as 75 percent (Figure 2). In June, ore from the main pit was fed directly through the mill which explained the sudden jump in recovery. Mill throughput (Figure 3), had a sharp decline early in the baseline period then gradually increased through June. Throughput variation was mainly due to problems with settling time in the thickeners. In extreme cases, the mill was idled due to the thickeners overflowing, which caused a decrease in the uptime.

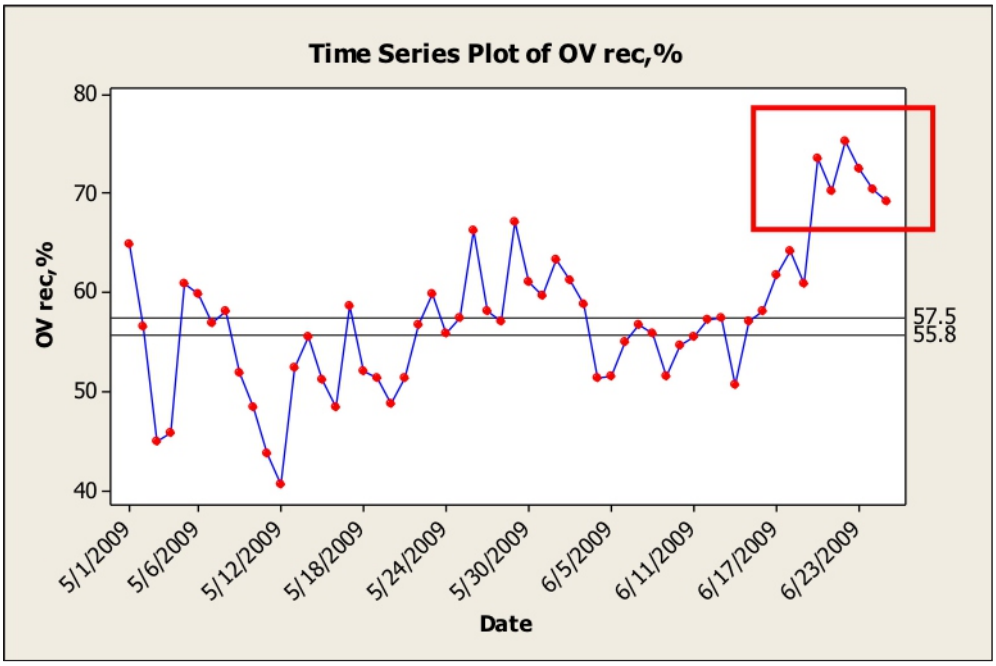

Figure 2 – Recovery Baseline Period

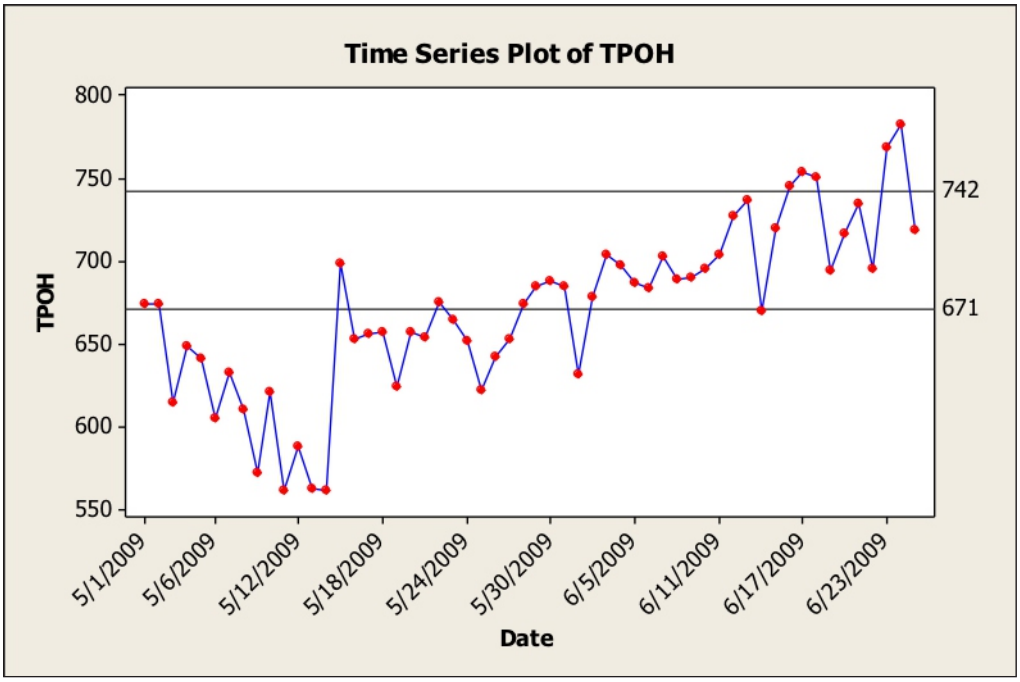

Figure 3 – Mill Throughput

Several factors impact recovery and throughput

The first step was to identify possible causes impacting mill recovery and throughput. The cross functional team — representing the mine, mill and geology — identified several factors both inside and outside the mill. A cause and effect matrix was created to prioritize the factors the team felt were the most significant. External factors having the highest wait were as follows:

- Feed pH
- Preg Robbing Index
- Feed Grade
- Stockpile Ore Control
- Blending Strategy
- Settling Time

The three main stockpiles were 12, 16 and 18. To ensure the ore characteristics were well understood, the stockpiles were drilled and sampled. Feed pH, preg robbing index (PRI) and feed grade (FLF) for the stockpiles are shown in Figure 4.

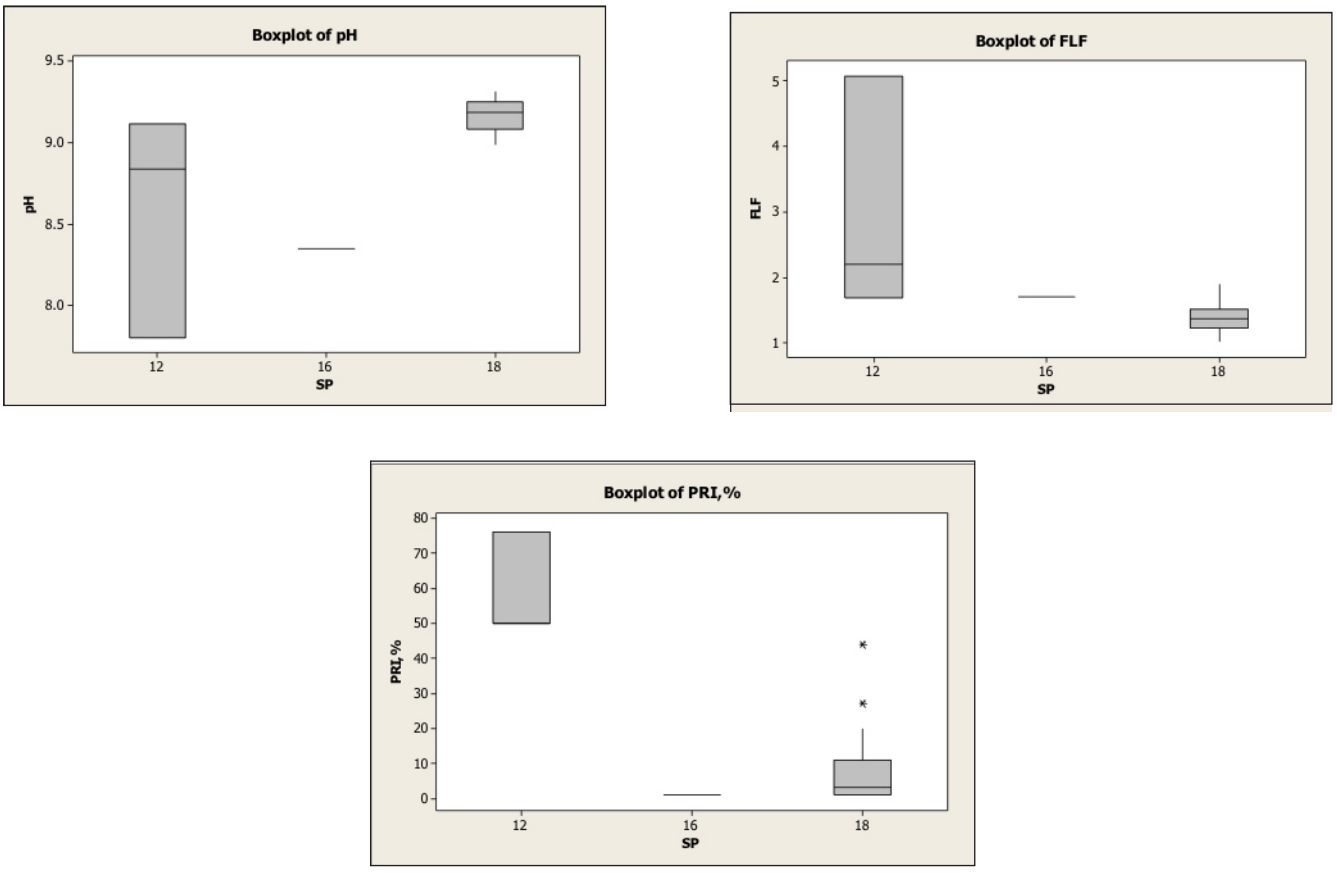

Figure 4 – Uptime Baseline Period

Only limited data was available for Stockpile 16 hence the characteristics were somewhat questionable.

In addition to the ore characteristics, the team also did settling tests on the stockpile samples. The data is summarized in Figure 5.

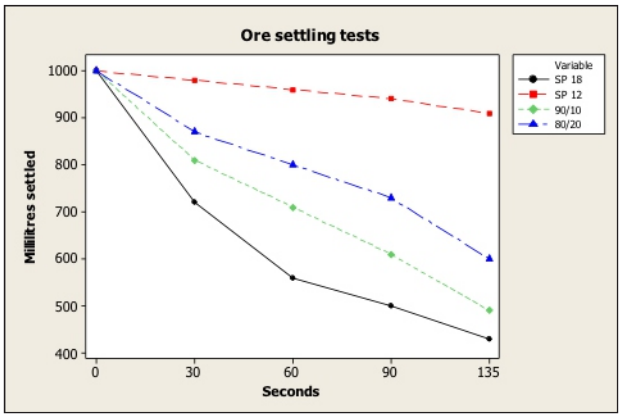

Figure 5 – Settling Time Test Results

Settling time was a key factor impacting throughput. From the plot, settling time for Stockpile 12 was much greater than for Stockpile 18. Settling time for the 90:10 and 80:20 blends are also provided. From the chart it can be concluded as the proportion of Stockpile 12 increased in the blend the settling time went up significantly.

Prior to the start of the project, the blending strategy was to pull ore from stockpiles to provide the mill with a target feed grade of 3 grams per ton. The decision for blending was primarily made by mine ore control. Mill personnel did not have a formal input into the process. The grade in Stockpile 12 ranged from 2 to 5 grams per ton making it difficult to maintain the target grade. To maintain the desired grade of 3, the proportion out of Stockpile 12 in the ore blend was typically set above 50 percent. The challenge with Stockpile 12 from a processing standpoint was that the pH was low, the PRI was high and the settling time was long.

The challenge of the team was to optimize the blending strategy in order to maximize recovery and throughput while maintaining the target feed grade. To address the challenge, an experiment was setup in the mill to evaluate the following parameters:

- Mill Throughput
- Stockpile Blend Mixture
- Feed Grade

Results of the study are shown in the contour plot (Figure 6). Mill throughput is represented on the vertical axes and the percent of Stockpile 12 in the blend is represented on the horizontal axis. Recovery is represented via the contours.

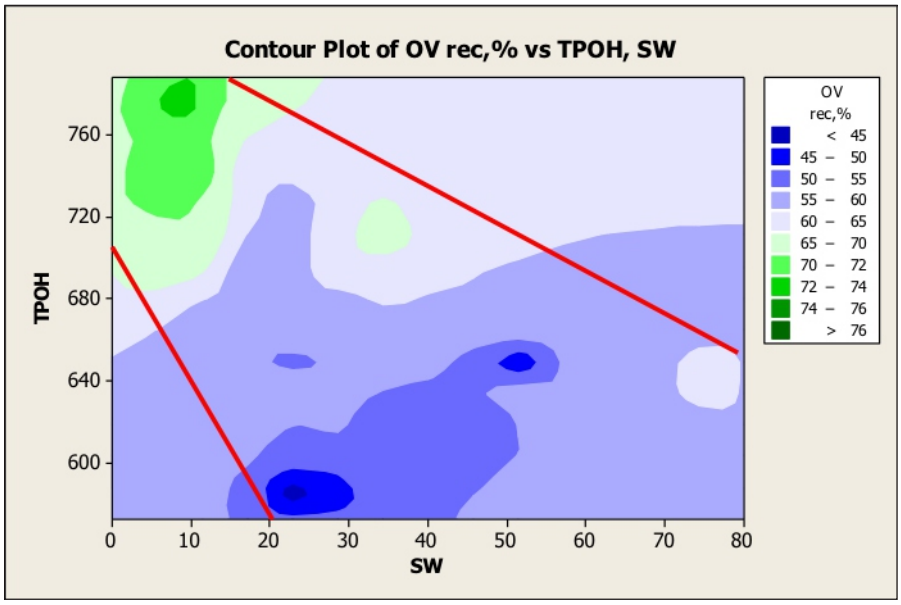

Figure 6 – Experimental Results

Results indicate that the recovery is maximized as long as the Stockpile 12 blend percentage is held below 10 and mill throughput is above 720 tons per operating hour. Recall, historically the blend had a ratio of Stockpile 12 above 50 percent. From the plot, the recovery when running the stockpile ratio above 50 percent ranged from 55 to 60 percent, which is what was experienced during the baseline period.

Based on the experimental findings, the team created a standard procedure for blending. To control the process, a blending team was created with the charter to create a weekly blending plan even when ore was taken from the main pit. Results for the three months following the project are shown in Figure 7. The Stockpile 12 blend contribution from July 2009 through October 2009 was set at 10 percent. The recovery averaged above 70 percent.

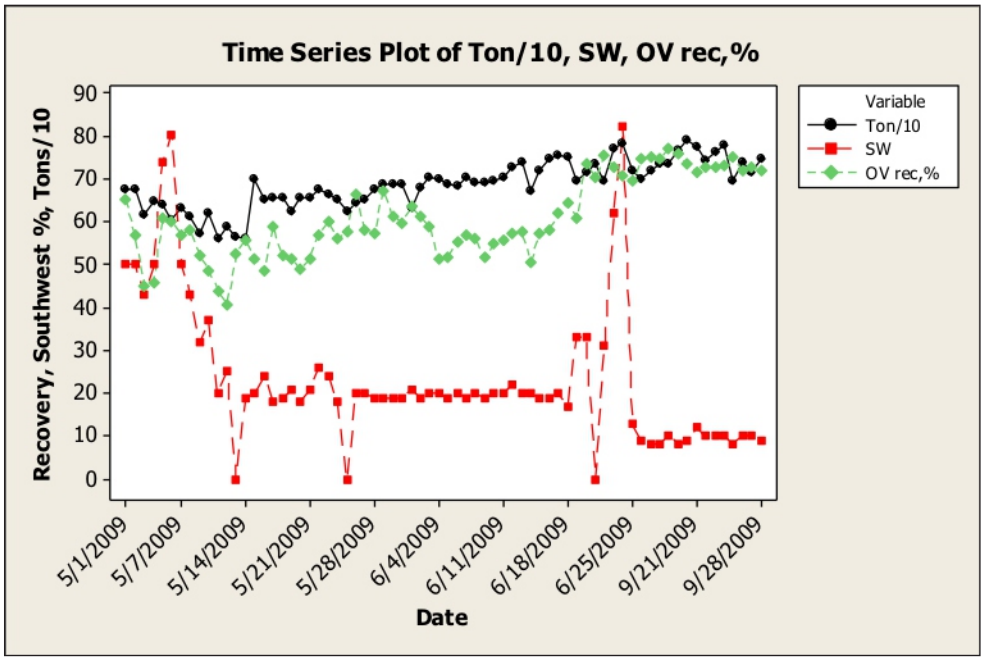

Figure 7 – Post Project Results

Project improves throughput, recovery; Benefit = $11.5 million

Increases in throughput and recovery were realized during this project. Recovery was increased from 58 percent to more than 70 percent and throughput from 671 to 742 wet tons/Op-hr. An additional benefit was the uptime was also increased as a result of the reduced setting time. The financial benefit of this project was more than $11 million dollars.

Stockpile Blending - Current State

Date:	5-1-09 to 6-25-10
671	Wet Tons/Op-hr
0.03	Moisture
650.87	Dry Tons/Op-hour
0.96	Uptime
14980.42	Tons/Day
2.12	Grade
31818.42	Grams/Day
0.584	Recovery
18585.14	Net Grams/day
599.52	Ounces/Day

Stockpile Blending - Future State

Date:	9-15-09 to 9-25-10	
742	Wet Tons/Op-hr	(Improvement due to elimination of Settling)
0.03	Moisture	
719.74	Dry Tons/Op-hour	
0.97259	Uptime	Note: Added 1.36 percent from actual to
16800.31	Tons/Day	account for thickener downtime only
2.10	Grade	
35280.65	Grams/Day	
0.737	Recovery	
25994.78	Net Grams/day	
838.54	Ounces/Day	

Stockpile Blending - Benefit

Benefit Tons/Oper - hr			71
Benefit Uptime			1.4%
Benefit Ounces/Day			239.0
Revenue Increase/day ($1000/ounce)		$	239,021
Revenue Increase 45 days ($1000/ounce)		$	11,233,973
Additional Cost of Stockpile Management	Annual	2 Months	
1 additional Loader/op-hr			$95
Cost for improvement period			$107,160
0 additional Trucks			
Project Benefit		$	11,126,813

NEXT STEPS ›

- Schedule a meeting with our team to learn about our enCompass® methodology and how IE can improve your operations.
- Interested in learning more about the topic covered in this case study? Call us at 1-312-967-4162 and reference the paper you're interested in. We would love to discuss your initiatives.
- Visit www.implementation.com to find out more about our services.

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We have volumes of success stories, and they can all be attributed to our revolutionary enCompass® methodology. This industry-first approach gives us not only the knowledge to inform you of what needs to be done, but the power to actually implement those solutions for lasting impact.

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