Comparaison des Résultats de dynamitage en utilisant la puissance consommée du concasseur et le tonnage de pierres produit

Par

Ron Glowe, ing.
Glowe Consulting Services Inc.
Longueuil, Québec, Canada

Résumé

Ce rapport démontre le potentiel d'un nouveau système informatique, le Glowe-Tech (GT) Quarry Analyzer, permettant de comparer les résultats de forage et dynamitage en utilisant les concasseurs et convoyeurs comme outils de mesure dans les carrières d'agrégats aux États-Unis et au Canada. Les données sont recueillies à l'aide de kilowatt transducers (disponible commercialement) et d'un module d'automation analogue. Il y a deux mesures différentes utilisées pour comparer les résultats. La première consiste en l'énergie consommée en kilowatts par tonne de pierres concassées par les concasseurs primaires et secondaires (optionnel). La seconde est le tonnage transporté par des convoyeurs clés pour montrer la séparation des produits et le taux de production. Si les lectures sur les balances des convoyeurs ne sont pas disponibles, le Glowe-Tech Tonnage des Analyser peut convertir les kilowatts consommés par le moteur du convoyeur en tonnage.

Ce processus de modélisation est à son meilleur lorsque les roches dynamitées sont excavées et concassées en séquence. Il y a plusieurs autres variables pouvant affecter les résultats tel que le type et les dispositions du concasseur, les dimensions des tamis et la géologie de la carrière. Cependant, si ces variables peuvent être standardisées, des tendances définitives peuvent alors être identifiées lors de la comparaison des résultats de forage et de dynamitage.

Le processus en entier peut être calibré et mis en œuvre en l'espace d'un jour ou deux. Le système fournit des données en temps réel graphiquement et en figure de tonnage total pour chaque section des opérations. Le GT Quarry Analyser est conçu pour être installé seul ou avec un automate existant dont il peut prendre plein avantage des fonctions.

Quelques-uns des avantages de ce nouveau système sont l'installation rapide de ses composantes, son faible coût et la facilité d'utilisation du programme informatique. Le GT Quarry Annalyser offre une nouvelle méthode pour comparer les résultats de production lorsque de nouveaux explosifs et détonateurs sont introduits ou lors d'un changement de méthode de forage.

Trois cas typiques montrent comment ce système peut être utilisé pour comparer les résultats. Le premier présente des améliorations du taux de production lors de l'introduction de détonateurs électroniques. Les deux autres cas montrent l'impact de la géologie sur le taux de production en utilisant des méthodes de forage similaires à différentes sections de la carrière. Après plus de quatre ans de développement, le GT Quarry Analyzer montre son plein potentiel pour permettre d'améliorer la productivité dans les carrières d'agrégats.

Blasting Results Compared Using Crusher Power Consumption and Tonnage of Rock Produced

by

Ron Glowe, P Eng.
Glowe Consulting Services Inc.
Longueuil, Quebec, Canada

Abstract

This paper shows the potential of a new computer model, Glowe-Tech (GT) Quarry Analyzer used to compare drilling and blasting results using the crushers and conveyors as measuring tools in aggregate quarries in the USA and Canada. All data is collected using commercially available kilowatt transducers and an analog input/output automation module. There are two areas of measurement used to compare results. The first area is the energy consumption in kilowatts per ton of rock crushed by the primary and secondary (optional) crushers. The second is the tonnage moved by key conveyors to show the split in products produced and the actual rate of production. If belt scale readings are not available then the Glowe-Tech Tonnage Analyzer can be used to convert kilowatts from the conveyor motor to tonnage.

This modeling process works best if blasts are mucked and crushed in sequence. There are many other variables such as crusher types, crusher settings, screen sizing and actual geology in the quarry that can influence the results, however if variables can be standardized then definite trends can be seen when comparing drilling and blasting results

The entire process can be set up and calibrated in a day or two. The system provides real time data, both graphically and in total tonnage figures for each area of the operation. The GT Quarry Analyzer is designed to be installed and take full advantage of features of an existing automat, or as a stand-alone system.

Some of the advantages of this new system are its quick installation of components, low cost and a simple to operate computer program. The GT Quarry Analyzer provides a new method to compare production results when new explosives or detonator products are introduced or a change in drilling pattern is tried.

Three actual test cases show how this system can be used to compare results, the first shows improvement in production rates when electronic detonators are introduced. The second and third shows the impact of geology on production rates using similar drill patterns at various bench elevations. After over 4 years of development, the GT Quarry Analyzer is showing its full potential to help improve productivity in aggregate quarries.

Background

This paper shows a new simplified method to compare blast fragmentation results. In the quarrying industry today, operators have a common goal to increase productivity and lower overall operating costs. Often it is easier to measure a localized improvement that sometimes can actually increase overall costs and lower production rates at other parts of an operation. What complicates this process is the multitude of variables that occur in the transformation of solid rock to a final rock size or series of sizes and shapes with the least amount of waste. Further complicating the overall picture is the ever-changing choice of products and equipment advertised by manufacturers as ways to lower costs and improve production. One of the greatest challenges facing operators is finding ways to easily measure productivity at each step in an operation to assure overall reduction in operating costs.

In industry today, beginning with drilling and blasting, there are many methods currently used to measure and compare results such as digital image analysis of blasted rock fragmentation, actual sieve analysis and time studies to excavate a blast. These methods give good results for individual parts of a blast, but not the entire blast. Then there are the variables of actual geology at the site that can vary from one location to the next. When crushing and screening rock, a whole new series of variables can influence the results, such as choice of crusher, actual settings of crushers and screens that will alter the results as the rock is processed. With all these variables it will always be difficult to find a single method that gives an actual overall comparison of results.

However with today's technology and computer assisted measuring devices it is possible to build a model that gives a much clearer picture on the actual energy consumption and production rates at each key step in the operation. Using this approach it has been found that such a model can be used to compare results of blasts and get a good correlation at the primary and secondary crushers to compare rates and final split in low-end fines and high quality crushed rock products.

In the simplest terms the process described herein is a new way to achieve the overall goal of reducing costs by comparing measurements of energy consumption in kilowatts per ton to crush rock, compared to the split of tonnage of rock produced at the final stockpiles. These measurements at crushers combined with conveyor tonnage rates give a clear picture of the overall productivity and help optimize total operating costs.

Measuring Equipment.

In the case of quarrying, where drilling and blasting is the first stage in the process to break rock for processing, there is a need for a low cost and fast method to optimize results from drilling and blasting to maximize production in the crushing and screening stages in the operation. To do this commercially available components are used to measure power consumption of crusher motors and conveyors.

In the case of crushers, an amp transducer is used to measure amperage, which is converted to kilowatt-hour consumption by the crusher motor to crush rock. The readings are either stored on a data logger or transferred to a computer via an automation module called an analog input/output module as shown in Figure 1. The readings are then compared to a no-load reading or idle operating level for the crusher and any readings above the no-load reading are then totalized to get the kilowatt-hour for the day while crushing rock as shown in the attached Figures 2 and 3.

This process has been demonstrated on jaw, cone and impact crushers. The end result is the actual tonnes of rock crushed per kilowatt-hour of energy consumed while crushing. All energy while running idle is excluded from the measurements.

The actual installation time of the equipment is a few minutes using a clamp on Current Transducer. The time to set up the computer program and calibrate each crusher is a few minutes depending on availability of the crusher to run idle for a few minutes after warming up for about 20 minutes.

To measure tonnage over conveyors coming out of crushers and to final stockpiles, conveyor belt scales are used with (Figure 4) with an integrator to read the tonnage (Figure 5). If belt scales are not available on key conveyors a new measuring device can be used that takes kilowatt power consumption from conveyor motors and converts the readings to tonnage using a real time computer program.

The device being used is a Glowe-Tech Tonnage Analyzer, which uses a watt transducer to get kilowatt readings from a conveyor motor. These readings are transferred to a data logger or computer using an analog input/output module (Figure 6). A real time computer program, the Glowe-Tech Quarry Analyzer then takes the kilowatt readings and compares them to the no-load reading equivalent to running the conveyor empty. If the reading is higher than the no-load reading this indicates there is rock on the conveyor, and these readings are converted to tonnage using a regression formula. The accuracy of this system depends on the angle of inclination and loading on the conveyor. If tonnage readings are over 25 tons per hour, then repeatable results between 1 and 3 percent can be achieved. The higher the tonnage rate, the more accurate the results.

The conveyor tonnage readings are used to give the factor for the crushers in establishing the tonnes per kilowatt-hour of crushed rock. To compare final production results daily tonnage rates over stockpile conveyors are measured and compared to secondary conveyor tonnages to establish the percentage of each rock type produced. These figures can establish the percentage of fines being produced. The key is to find the optimum operating level to achieve maximum production at the lowest cost with the least amount of fines. The modelling process can also be used to check percentage of final products produced when changes are made in screen sizes and crusher settings.

Set up time and cost of components for the conveyor tonnage measuring systems are higher depending on models selected compared to the crusher system. There is also additional time to calibrate the belt scale or Glowe-Tech Tonnage Analyzer compared to the crusher equipment.

Blast Comparison

To begin the modelling process the first step is to determine the best points to set up the measuring equipment. Ideally a full set up would include the primary and secondary crushers, followed by the primary and secondary feed conveyors, and finally the main stockpile conveyors. Once the equipment is set up and the program calibrated for each input a base line can be established. With a base line established it is possible to start making changes and comparing results to the base line cases. One of the keys to the success of this modelling process is to minimize variables. The best results will be achieved when all drilling and blasting is carried out in the same area of a quarry in similar geological conditions. The best possible base line can be achieved if similar drill patterns and explosive loading can be maintained. It is also preferable if each blast is mucked individually to avoid blending with other muck piles, which will distort results. If some blending occurs and the time is known then these results can be isolated from the test data.

One of the keys to the success of this process is the ability to easily identify loss of production at each step in the operation that shows up as “no-load” time. Reducing “no-load" time, that is often a direct result of oversize rock, can often be achieved by spending more money on drilling and blasting to reduce oversize. In this new process the added cost at the drilling and blasting stage can be compared to downstream changes in production with a target of lowering overall operating cost.

There are many variables that influence the overall production process. The measurements taken will provide indications of trends and will generate repeatable and accurate results. For the conveyors and the primary crusher, the automatic zeroing function used with watt transducers requires about 2 minutes of idle operation time to re-calibrate the GT Quarry Analyzer. This daily zero test will filter out most outside variables that may otherwise distort readings. With use, other variables will be identified, and ways can then be established to filter out or include new data to better refine the overall process.

To date a full-scale test using input from primary and secondary crushers and all key stacker conveyors at the same time as described above has not been carried out. However, the described model has been run in parts at several test sites over the past 4 years demonstrating measurable improvements in production. What is clear is that with more input, the results can be refined thus expanding the capabilities of the modeling process.

To demonstrate the capabilities of the GT Quarry Analyzer computer model results from 3 evaluation sites are summarized. At the first quarry the results are compared using non-electric detonators (Handidet), with an (Orica i-kon) electronic initiation system. The other two quarry evaluations involved comparing results on different benches using similar drill patterns, with similar explosive loading and comparing the production through the primary crusher and changes in fines production.

CASE STUDIES

Case Study 1

Results from Five Blasts monitored with Muck coming only from the identified Blast.

The first site analyzed results from five evaluation blasts in a granite aggregate quarry in the southern USA. In each blast the muck was monitored when it was coming from a specific blast. Some days of data were not included in this summary where muck was blended from other blasts.

The kilowatt-hours of energy consumed by the primary jaw crusher when the crusher was crushing rock each day was calculated. This figure divided by the daily tonnage from the belt scales gives the actual tons of rock crushed per kilowatt of energy consumed for each day. The other part of the study was to calculate production time for the primary crusher compared to no-load time each day. Using the actual belt scale tonnage for the day and the actual production hours, the tons per hour produced by the primary crusher were calculated.

Initial assessment for blasts along the NS axis show little difference in energy consumption to crush the rock when blasted with non electric detonators versus electronic detonators on the same pattern and explosive loading. However throughput assessment shows a 106 ton per hour increase in the blast with electronic initiation.

In the NS direction, results from non-electric blasting are compared to electronic initiation with the same drill pattern. Tons per hour production through the primary crusher went up 116 tph, and tons crushed increased 30% per kilowatt-hour of energy consumed with the electronic initiation on the same pattern and timing. A second electronic initiation blast with the same pattern and timing produced even better results.

A key outcome from this evaluation is a proven measurement system to evaluate blast optimization efforts. Table Figure 7 summarizes these test results.

Case Study 2

Results from several months of Blasting in varying Geological Conditions

The second site is a Schist quarry in Sherbrooke area operating on 3 levels with varying geology. The blasting was carried out using the same drill pattern and explosive loading for each bench as shown in the attached table figure 8 & 9. What is most evident from this quarry is that when the blast is well broken with not much oversize we get a big increase in production. The quarry is looking at a way to modify drill patterns based on how difficult the rock is to drill ie more difficult the drilling, the smaller the drill pattern and vice a versa if the rock is easy to drill and now we can measure the results.

Case Study 3
Results of Blasting in varying Geological Conditions

The third site is a Limetone quarry on the south shore of Montreal operating on 2 benches with varying geology. In this quarry blasting is carried out using 3 main pattern sizes depending on location. Here again results vary and the largest factor effecting production is the amount of oversize from the blast. The coarser material slows up production however when the rock is very well broken the percentage of fines goes up as shown in Figures 10. Now with the installation of the Glowe-Tech Tonnage analyzer we will be able to better design blasts in the future based on results from various areas of the quarry .

Recommendations for future Quarry Production Studies:

The use of the data logger in the first case study permitted unattended recording of data for up to 2 weeks using 3 channels of input (left corner Figure 6). One of the disadvantages of this system was the requirement to transfer this data to spreadsheets to convert the data into tonnage for conveyors and kilowatt-hour consumption of energy for crusher productivity (Figure 2). Each spreadsheet takes about 5 to 10 minutes to complete.

In more recent installations the data logger was replaced with a Momentum Analog Input/Output module to transfer the 4-20ma input signal from watt transducers directly to the computer similar to a PLC used in automation control. All these components are industrial grade units used in automation control (Figure 11). The real time Glowe-Tech Quarry Analyzer program has been designed to be very easy to operate, and comes ready to install local parameters to calibrate the system. The computer used to store data and run the calculations can be a desktop PC or an industrial touch screen PC. All programming is designed to handle up to 8 channels of data on the same screen display with a graphic display of all conveyor or crusher productivity for the last 10 minutes shown as part of the real time display (Figure 12). To further simplify installations a low cost, wireless system using high gain external antennas was set up at test site 2 to provide transmission of data from the electrical room to the office.

Conclusion

Using tonnage over conveyors and power consumption rates in kilowatts at crushers provides a new way to compare blasting results and show the impact on the full process when changes are made at the drilling and blasting stage. At many operations today the drilling and blasting stage is often under pressure to reduce costs, as are other parts of the operation. Drilling and blasting is one of the easiest areas to measure input costs, and reduced spending at this stage often results in larger fragmentation and reduced productivity, which is more difficult to measure.

The Glowe-Tech Quarry Analyzer helps to insure any changes occurring in one area can be easily measured throughout the production process to confirm if an overall improvement has been achieved. The multi functional nature of this computer model ensures all areas of the plant working at optimal levels, and any benefits from new products or equipment will be measurable to see their impact on the production cycle.

The current computer model using automation control devices to collect and analyze data keeps output data in a format that is easy to read and interpret. The overall process can be further expanded to include additional input data such as use of mechanical breakers at primary crushers, loader and truck scale readings. This additional information may be useful in comparing blasting results; however this still needs further research. The main benefit of the present Glowe-Tech Quarry Analyzer computer model is to assist industry to better understand the overall process and integrate all operations to optimize overall productivity.

Ron Glowe, September 30, 2005

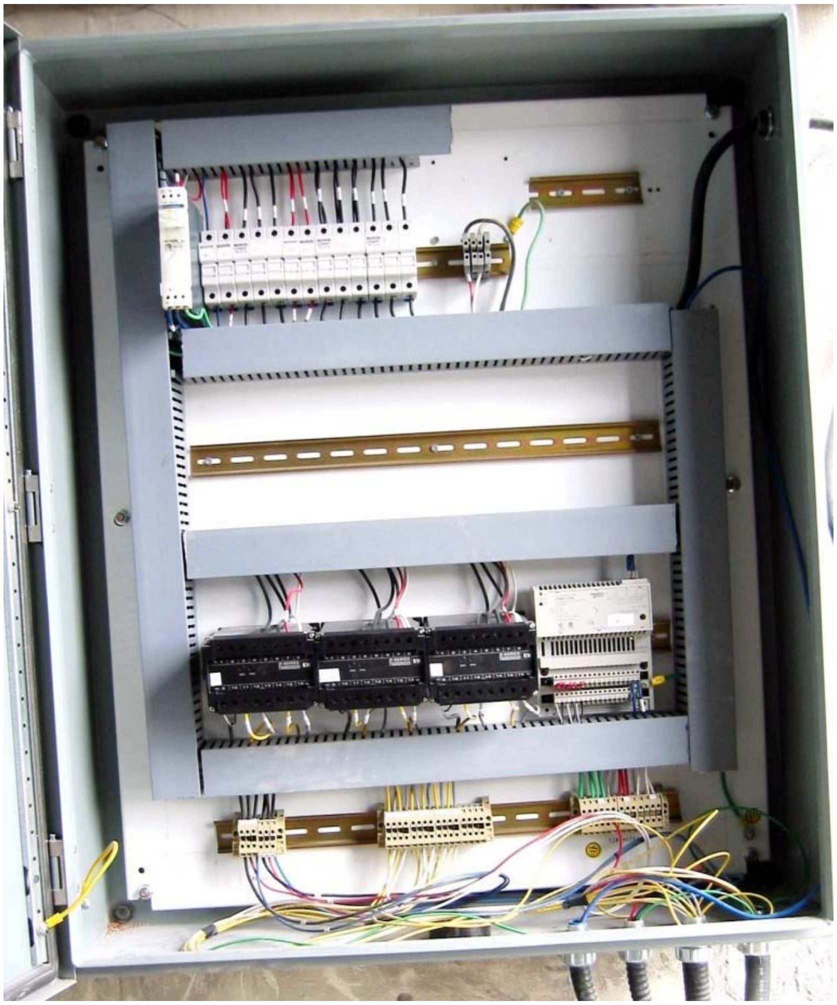
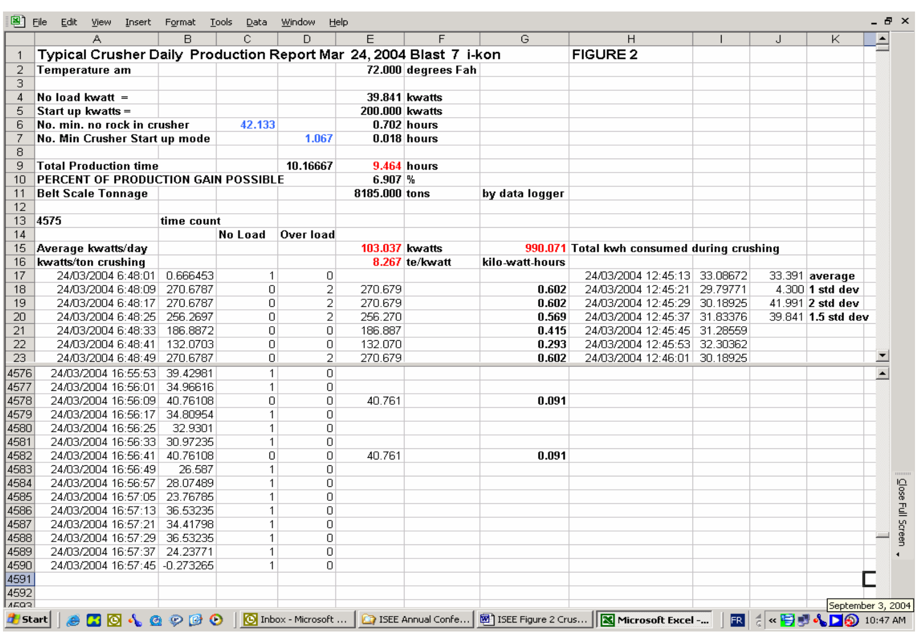


Figure 1: Analog input/output module with Ethernet communication card and data logger as alternate method of storing data or relaying to computer



	A	B	C	D	E	F	G	H	I	J	K
1	Typical Crusher Daily Production Report Mar 24, 2004 Blast 7 i-kon							FIGURE 2			
2	Temperature am				72.000	degrees Fah					
3											
4	No load kwatt =				39.841	kwatts					
5	Start up kwatts =				200.000	kwatts					
6	No. min. no rock in crusher		42.133		0.702	hours					
7	No. Min Crusher Start up mode			1.067	0.018	hours					
8											
9	Total Production time			10.16667	9.464	hours					
10	PERCENT OF PRODUCTION GAIN POSSIBLE				6.907	%					
11	Belt Scale Tonnage				8185.000	tons	by data logger				
12											
13	4575	time count									
14			No Load	Over load							
15	Average kwatts/day				103.037	kwatts	990.071	Total kwh consumed during crushing			
16	kwatts/ton crushing				8.267	te/kwatt	kilo-watt-hours				
17	24/03/2004 6:48:01	0.666453	1	0				24/03/2004 12:45:13	33.08672	33.391	average
18	24/03/2004 6:48:09	270.6787	0	2	270.679		0.602	24/03/2004 12:45:21	29.79771	4.300	1 std dev
19	24/03/2004 6:48:17	270.6787	0	2	270.679		0.602	24/03/2004 12:45:29	30.18925	41.991	2 std dev
20	24/03/2004 6:48:25	256.2697	0	2	256.270		0.569	24/03/2004 12:45:37	31.83376	39.841	1.5 std dev
21	24/03/2004 6:48:33	186.8872	0	0	186.887		0.415	24/03/2004 12:45:45	31.28559		
22	24/03/2004 6:48:41	132.0703	0	0	132.070		0.293	24/03/2004 12:45:53	32.30362		
23	24/03/2004 6:48:49	270.6787	0	2	270.679		0.602	24/03/2004 12:46:01	30.18925		
4576	24/03/2004 16:55:53	39.42981	1	0							
4577	24/03/2004 16:56:01	34.96616	1	0							
4578	24/03/2004 16:56:09	40.76108	0	0	40.761		0.091				
4579	24/03/2004 16:56:17	34.80954	1	0							
4580	24/03/2004 16:56:25	32.9301	1	0							
4581	24/03/2004 16:56:33	30.97235	1	0							
4582	24/03/2004 16:56:41	40.76108	0	0	40.761		0.091				
4583	24/03/2004 16:56:49	26.587	1	0							
4584	24/03/2004 16:56:57	28.07489	1	0							
4585	24/03/2004 16:57:05	23.76785	1	0							
4586	24/03/2004 16:57:13	36.53235	1	0							
4587	24/03/2004 16:57:21	34.41798	1	0							
4588	24/03/2004 16:57:29	36.53235	1	0							
4589	24/03/2004 16:57:37	24.23771	1	0							
4590	24/03/2004 16:57:45	-0.273265	1	0							
4591											
4592											

FIGURE 2: Typical Excel spreadsheet program used to convert crusher motor kilowatt readings to tonnage using data logger readings taken at 8 second intervals.

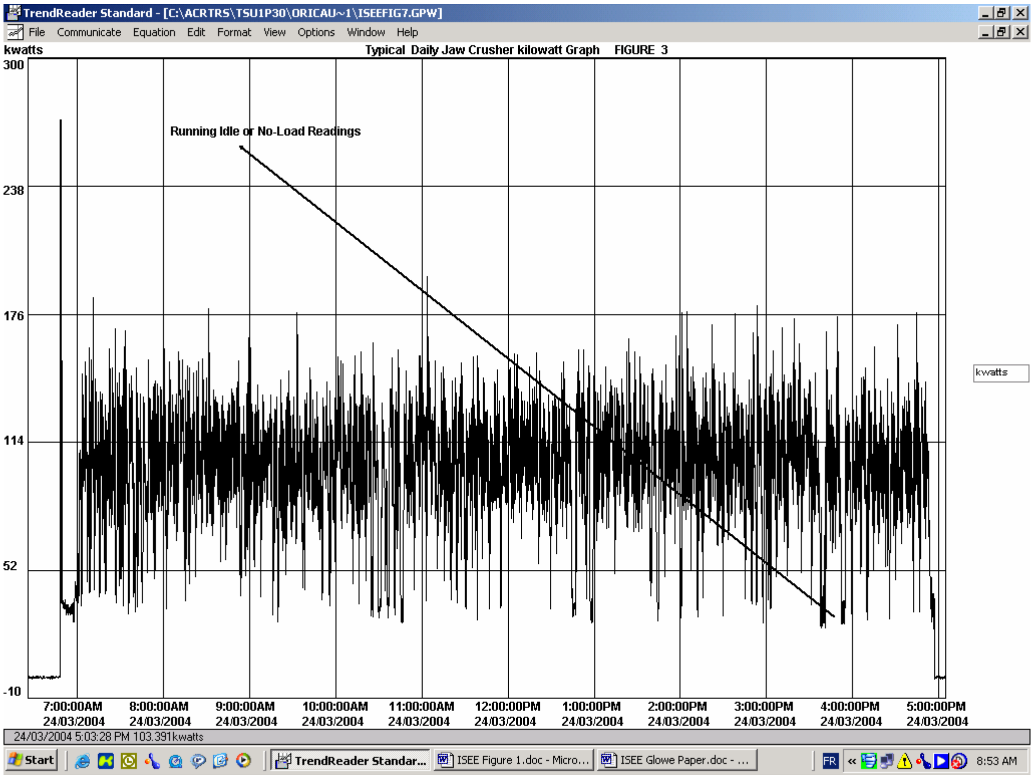


FIGURE 3: Typical daily graph of kilowatt consumption by jaw crusher with few minutes of idle operation or no-load as indicated by arrow.

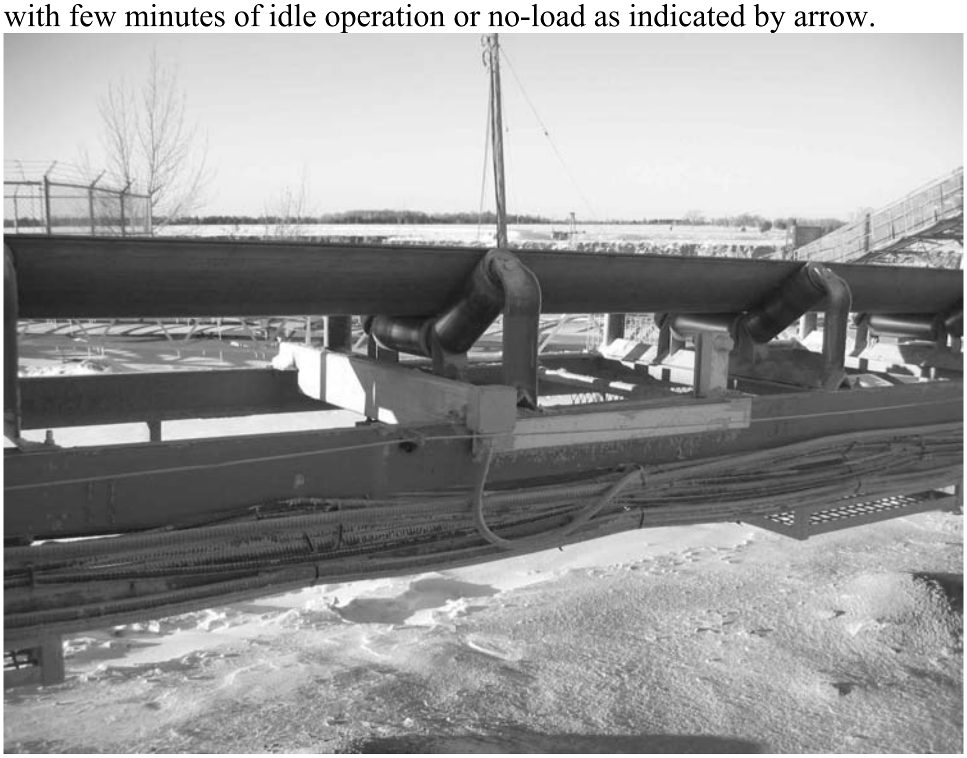


Figure 4 Typical Belt Scale mounted on a conveyor

Figure 5 Belt scale integrators used to show tonnage rates and accumulated tonnage.

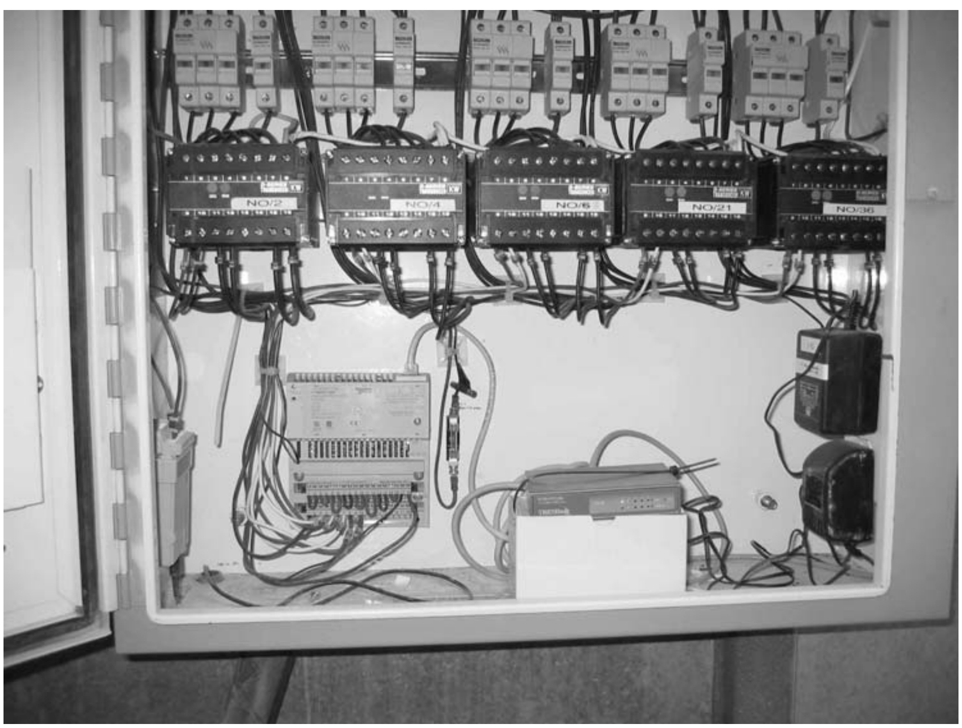


Figure 6: Typical Cema 4 panel showing installation of watt transducers for 5 conveyors with I/O module, data Logger and Ethernet communications to wireless network

FIGURE 7a:- Picture Case Study 1 Typical Blast Fragmentation

FIGURE 7b:- Granite Aggregate Quarry Production Summary for Primary Crusher over 5 Blasts

DATE	Blast	Primary Crusher Operating time hours	No-load hours	Production hours	Belt Scale tons	Ton/hr	GT Tonnage	kwhr	Tons / kwhr	Avg tons/kwhr	Difference Belt Scale vs GT Analyzer
Jun-03	Non Electric EW 1	43.38	5.98	37.42	37553	1003.5	0	3637.80	10.323	10.380	0
Jun-03	Electronic EW 3	58.25	15.77	42.37	47045	1110.3	46863	4576.00	10.061	10.14	0.39%
Jun-03	Non Electric NS 2	51.53	13.42	47.22	44431	940.9	0	5676.15	7.828	7.829	0
Oct-03	Electronic NS 4	32.92	11.49	21.42	22915	1055.1	23077	2180.50	10.465	10.784	-1.13%
Oct-03	Electronic NS 5	35.00	9.16	25.84	30250	1170.8	30126	2342.40	12.914	12.629	0.41%

Fine Fragmentation

Medium Fragmentation with some oversize

Coarse Fragmentation with a lot of oversize

FIGURE 8:- Pictures Typical Blasts Test Site 2

Figure 9:- Case Study 2 Primary Jaw Crusher Production Results by Bench

Date	Bench	Tonnage	Production Time	tons/hr GT	ton/kwhr	Blast	Drill pattern
1-Jun-05	#1	6237	7,97	784	7,046		
6-Jul-05	#1	6530	9,25	706	5,866		
29-Aug-05	#1	5045	8,77	575,5	3,325		
31-Aug-05	#1	1847	3,14	588,6	3,279		
6-Sep-05	#1	6882	9,17	750,4	5,881		
7-Sep-05	#1	3684	5,37	689,03	5,239		
8-Sep-05	#1	4140	8,14	508,74	3,840		
9-Sep-05	#1	3861	7,17	538,24	4,487	17-Bench 3	3.4 x 3.4--6.25in
12-Sep-05	#1	6953	9,25	751,6	6,806		
13-Sep-05	#1	6277	9,40	667,9	4,940		
14-Sep-05	#1	4830	9,47	509,85	3,170		
22-Sep-05	#1	5887	9,45	622,7	4,220		
Average		**5181,083**		**641,047**	**4,842**		
5-Aug-05	#2	5681	8,43	493,6	4,027		
12-Aug-05	#2	6338	9,64	669,8	4,754		
15-Aug-05	#2	5880	9,49	619,5	3,986		
17-Aug-05	#2	4438	7,37	601,9	3,962	14-Bench 1	3.6 x 3.6--6.25in
18-Aug-05	#2	6533	9,58	681,8	4,852		
19-Aug-05	#2	5607	8,88	631,4	4,104		
22-Aug-05	#2	1397	2,47	564,8	3,551		
Average		**5124,857**		**608,971**	**4,177**		
27-Jun-05	#3	5643	8,36	676	5,249		
28-Jun-05	#3	5474	8,05	681	4,727	8- Bench 1	3.6 x3.6--6.25in
7-Jul-05	#3	5300	9,90	536	3,548		
11-Jul-05	#3	6240	9,69	644	4,526		
12-Jul-05	#3	5660	8,75	647	4,495		
13-Jul-05	#3	5633	8,86	639	4,572		
14-Jul-05	#3	5517	8,65	638	4,406		
18-Jul-05	#3	5843	10,00	594	4,238		
20-Jul-05	#3	4390	8,94	485	3,012		
21-Jul-05	#3	4539	8,85	496	2,970		
22-Jul-05	#3	4498	8,67	519	3,122		
25-Jul-05	#3	5684	8,60	519	3,147	11- Bench 3	3.4 x 3.4--6.25in
26-Jul-05	#3	5684	8,54	665,4	4,499		
27-Jul-05	#3	5862	9,56	613,3	4,138		
28-Jul-05	#3	5079	8.70est	584	4,957		
2-Aug-05	#3	4381	8,99	490	2,981	12-Bench 2	3.5 x 3.5--6.25in
3-Aug-05	#3	4595	9,38	483	2,912		
16-Sep-05	#3	6857	9,39	730,5	5,571		
19-Sep-05	#3	6716	8,65	776,3	6,479		
Average		**5452,368**		**600,868**	**4,187**		

Blast 1:- 3.65m x 4.25m-------Blast 2:- 3.65m x 4.25m & 3.95m x 4.25m

Blast 3:- 3.35m x 3.95m with 115mm dia. drill hole

Figure 10:- Typical Blasts at Test Site 3

FIGURE 11 Summary of Results Test Site 3

Date	Bench	GT Tonnage te	CV01 Time hours	tph CV01 tph CV01	Time Crushing hours	tph Crusher tph	te/kwhr	Blast	Drill Pattern
21-Jul-05								blast 5	3.35m x 3.95m & 3.65m x 3.95m
8-Aug-05								blast 6	3.35m x 3.95m
15-Aug-05								blast 7	3.65m x 4.25m & 3.35m x 4.25m
25-Aug-05								blast 8	3.65m x 4.25m
19-Sep-05	#1	3492	6.36	549.06	5.24	622.6	8.603		
20-Sep-05	#1	3049	5.32	573.44	5.24	581.9	9.072		
21-Sep-05	#1	3110	4.89	635.99	4.71	660.1	10.558		
22-Sep-05	#1	1737	3.19	544.86	3.42	507.2	7.827		
26-Sep-05	#1	3043	5.66	537.63	5.30	574.4	8.773		
27-Sep-05	#1	3201	5.83	548.97	4.95	646.7	10.299		
28-Sep-05	#1	3448	6.12	563.61	4.53	760.3	11.702		