

OPTIMISATION OF ASANKO'S SABC CIRCUIT TO ACHIEVE PROJECT 5 MILLION

Technical Presentation to the 14th AusIMM Mill Operators' Conference 2018

29 August, 2018

ASANKOGOLD

AGENDA

- Overview of the Asanko Gold Mine
- Project 5 Million Objective
- Upgrades
  - Metallurgical
  - Volumetric
- Challenges and Solutions
- Performance
- Conclusion



ASANKO AT A GLANCE

- **Large Scale, Long Life, Multi-Pit Asset**
  - 11 open pit deposits
  - 6.6Moz M&I Resources* & 5.1Moz Reserves*
  - 5Mtpa CIL processing capacity
  - Jointly owned with Gold Fields 50:50

- **2018 Guidance:** 200-220,000oz @ AISC $1,050 - 1,150/oz

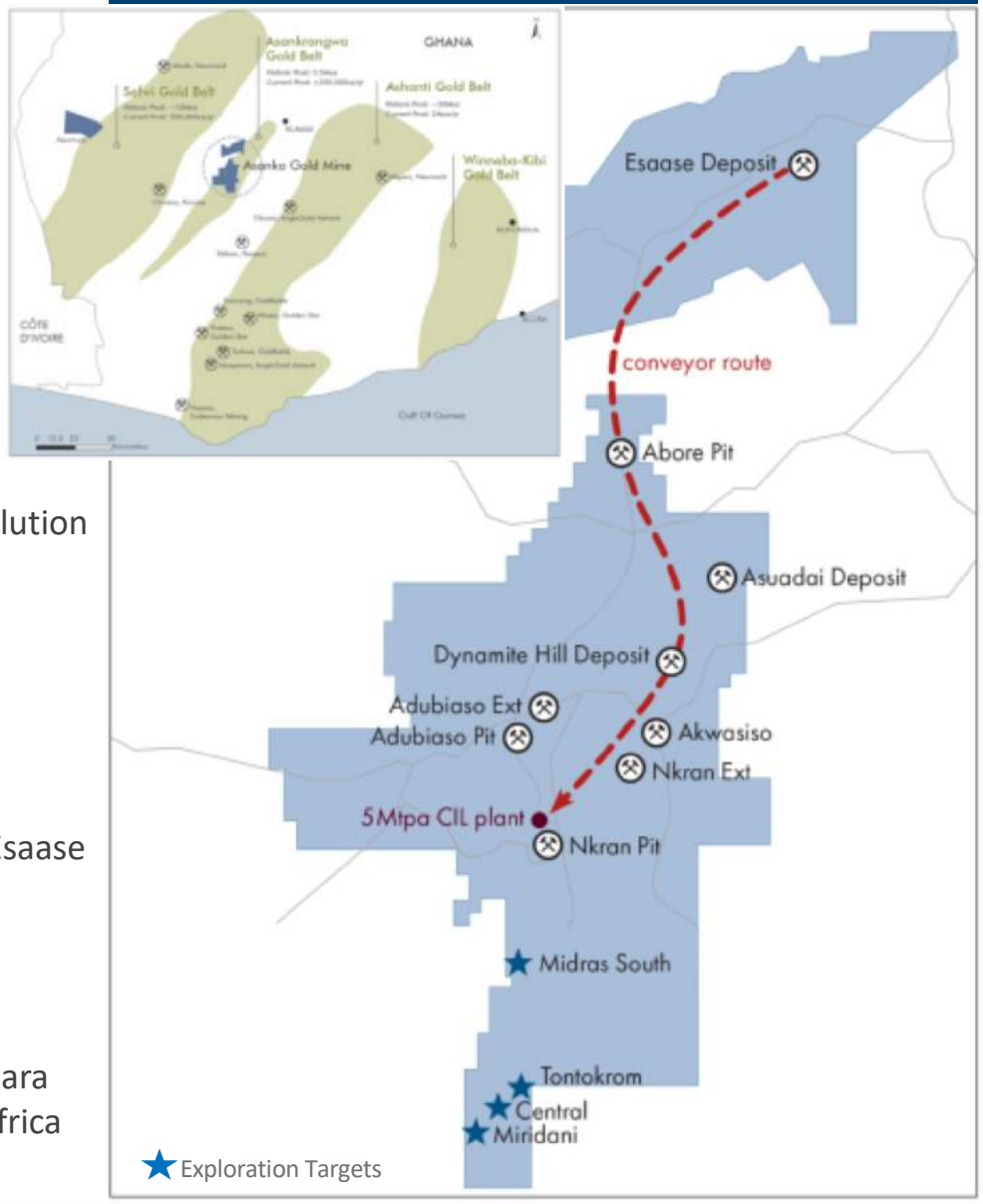
- **Near-Term Growth => Development of Esaase**
  - Trucking operation commencing Q1 2019
  - Overland conveyor identified long term as transport solution

- **Highly Prospective Land Package => Future Growth**
  - Largest holder on highly prospective Asankrangwa Belt
  - Significant exploration potential

- **Strong Social License to Operate**
  - Successfully permitted current mine, development of Esaase & overland conveyor
  - Excellent world class safety record, over 1 year LTI-free

- **Stable Jurisdiction**
  - Ghana is longest functioning democracy in the sub-Sahara
  - Gold mining +100 years, ranked 10th globally & 2nd in Africa

The 11 Multi-Pit Asanko Gold Mine Complex



* = as at 31 December 2016

P5M OBJECTIVE

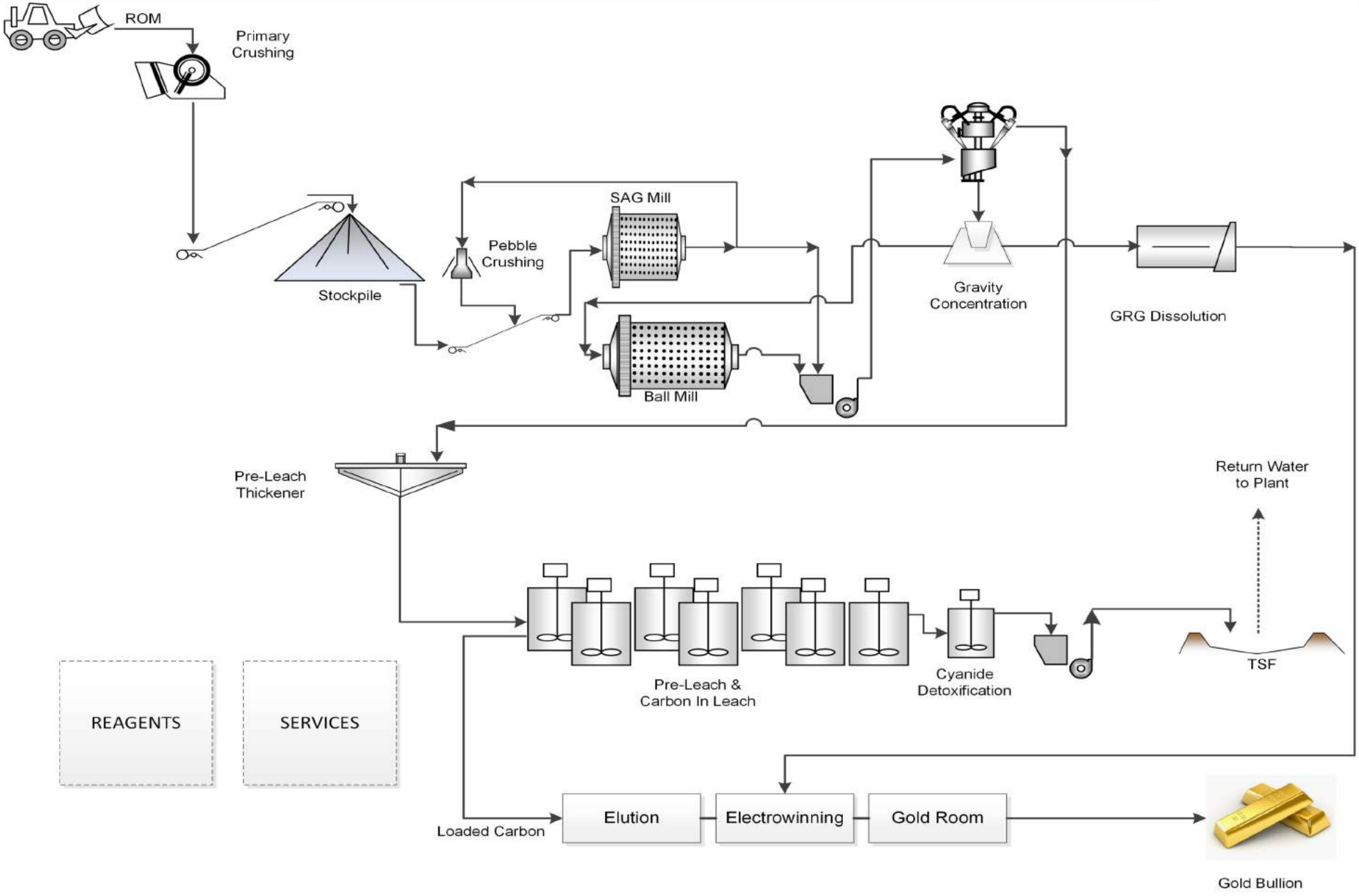
Project 5 Million (P5M)

- In 2016 the DFS identified the processing plant could be increased from 3Mtpa to 5Mtpa capacity for US$29m
- The plant upgrade required both volumetric and metallurgical modifications
- In 2017 an execution plan was put in place to upgrade the plant to deliver 5Mtpa by Q3 2017 while maintaining metallurgical performance





PROCESSING PLANT FLOWSHEET



P5M UPGRADES

Metallurgical

- Additional Knelson and Intensive leach Reactor
- Additional 5tpd Oxygen plant
- Additional Electro winning capacity
- Larger water handling tank

Volumetric

- An additional tailings line
- Larger Inter tank screens
- Increase diameter pipeline on cyclone overflow line
- Larger pump and delivery line on thickener underflow







MAJOR CHALLENGES IN ACHIEVING P5M

- Lack of understanding of ore hardness and Bond Work Index (BWI) requirements from the various ore types
- Poor mill feed fragmentation due to inadequate crushing capability at the new tonnages
- Insufficient oxide in feed blend
- Poor SCADA control which allowed operator intervention

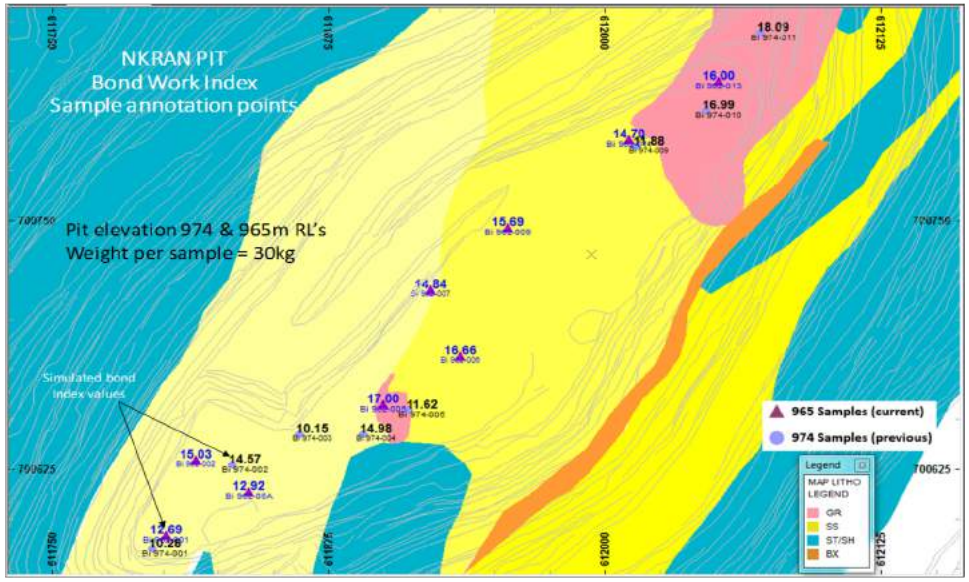




SABC CIRCUIT OPTIMISATION STEPS

- Principles of the MillSlicer
  - SAG Mill Load vs SAG Mill Power understanding
- Incorporation of the BWI into Polygons
  - Changes within the pit
- Development of the Geomet Model
  - Used for prediction of production and mill feed planning
- Mill Power and Control System Optimization
  - SCADA PID loop control
- BWI Determination
  - Tarkwa University
- Mine to Mill Fragmentation
  - Increase crushing capability
- SAG grate discharge port surface increased by 35%
  - Push more load quicker to the ball mill





MILLSLICER - AN INTELLIGENCE CONTROL SYSTEM

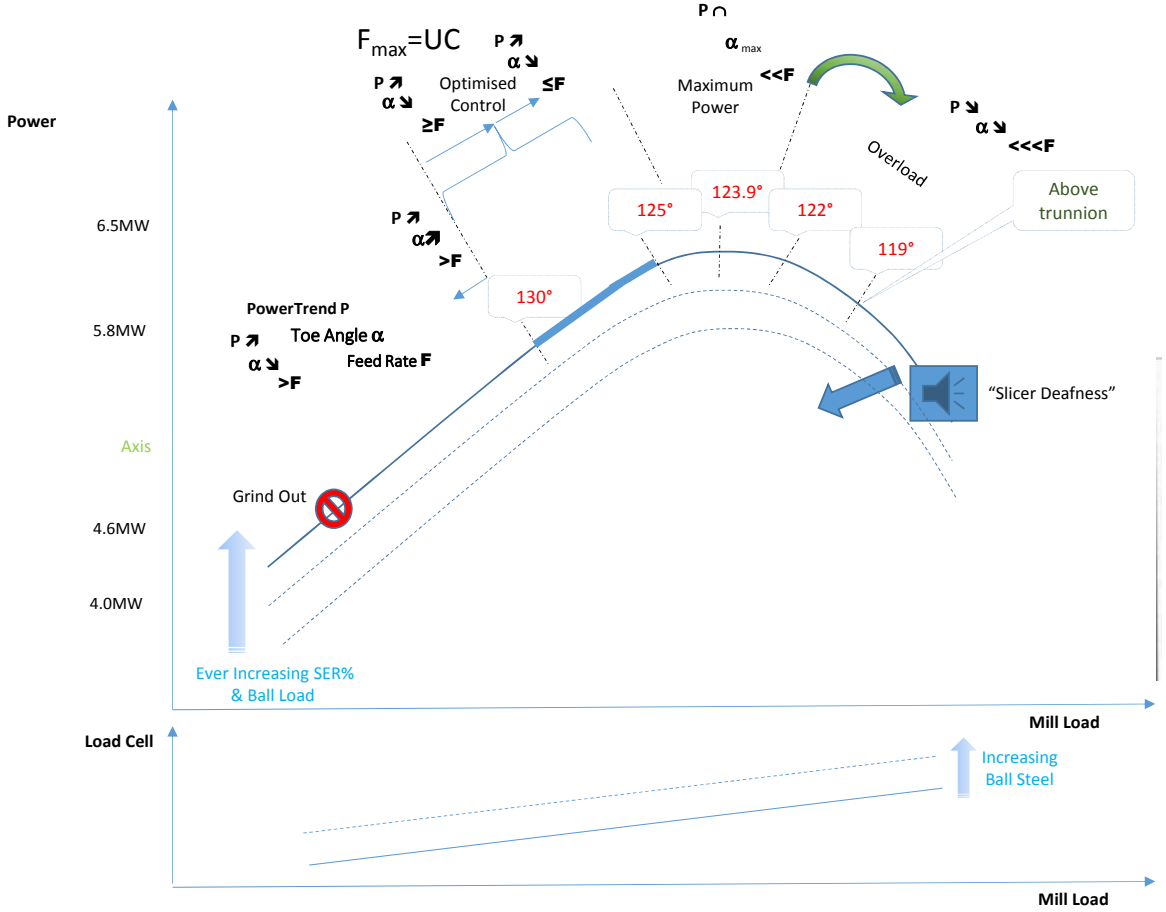
- MillSlicer Technology is an instrument that monitors the SAG mill load position, the toe angle and optimises the SAG mill power conditions
- The MillSlicer prevents the mill from overloading , back spilling or underfeeding
- The MillSlicer also controls feed lower & upper clamp set points





MILL SLICER – AN INTELLIGENT CONTROL SYSTEM

Principle of the Slicer Control System



Operational Change	Mill Power (MW)	Toe Angle
> =	↗	↗
Overload	↘	↘
Filling Up	↗	↘
Emptying	↘	↗

Benefits of Slicer intelligence system:

- Less human intervention & thus controls lower & upper clamp of feed set point
- Steady increase and decrease of feed rate in advance preventing over and underload conditions
- Steading control result in better throughput

MILL SLICER - AN INTELLIGENT CONTROL SYSTEM

Three basic parameters to control the mill toe angle includes:

- **Oxide feed blend** – Rhelogy
- **BWI of feed ore** – Blended crusher feed plan
- **Fragmentation** - % passing 80mm

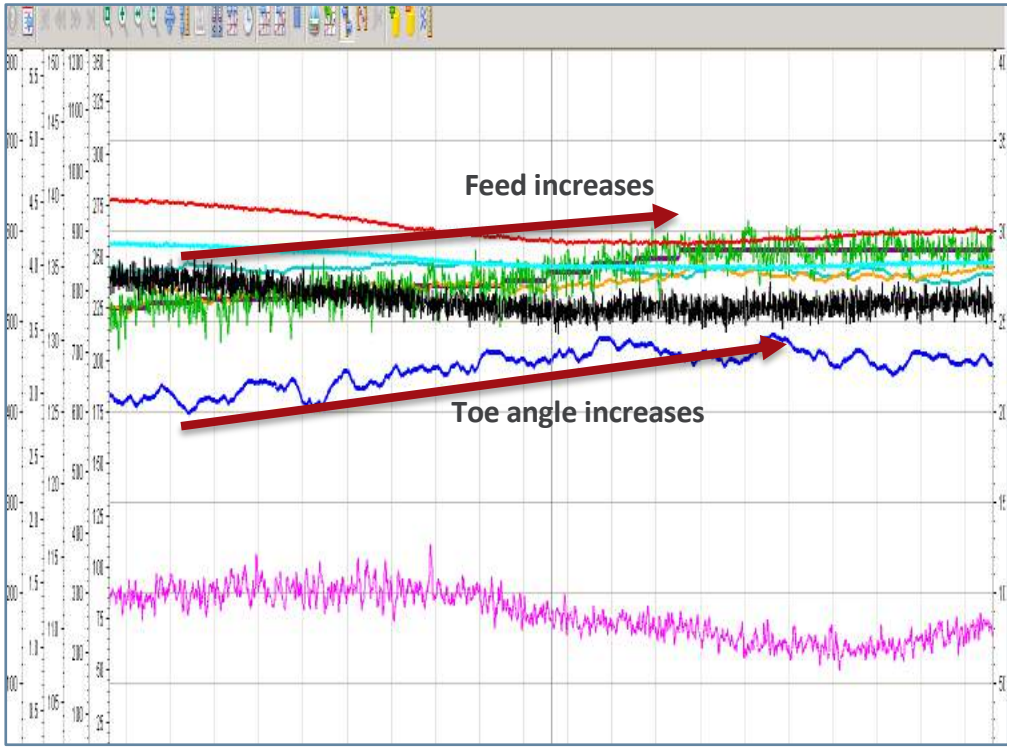




MILL POWER AND CONTROL SYSTEM OPTIMISATION

Development of the Rules Based System (RBS) Control Philosophy



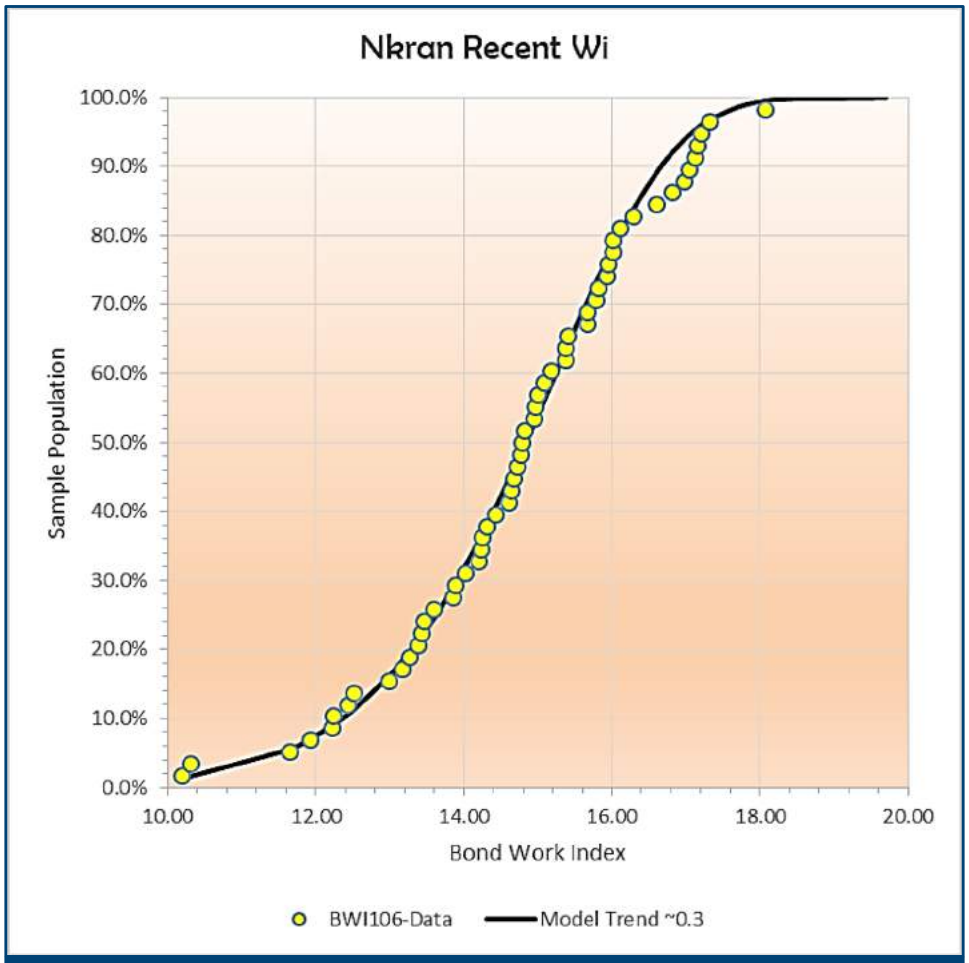


The toe angle is used as primary process variable to optimise the SAG mill control stability:

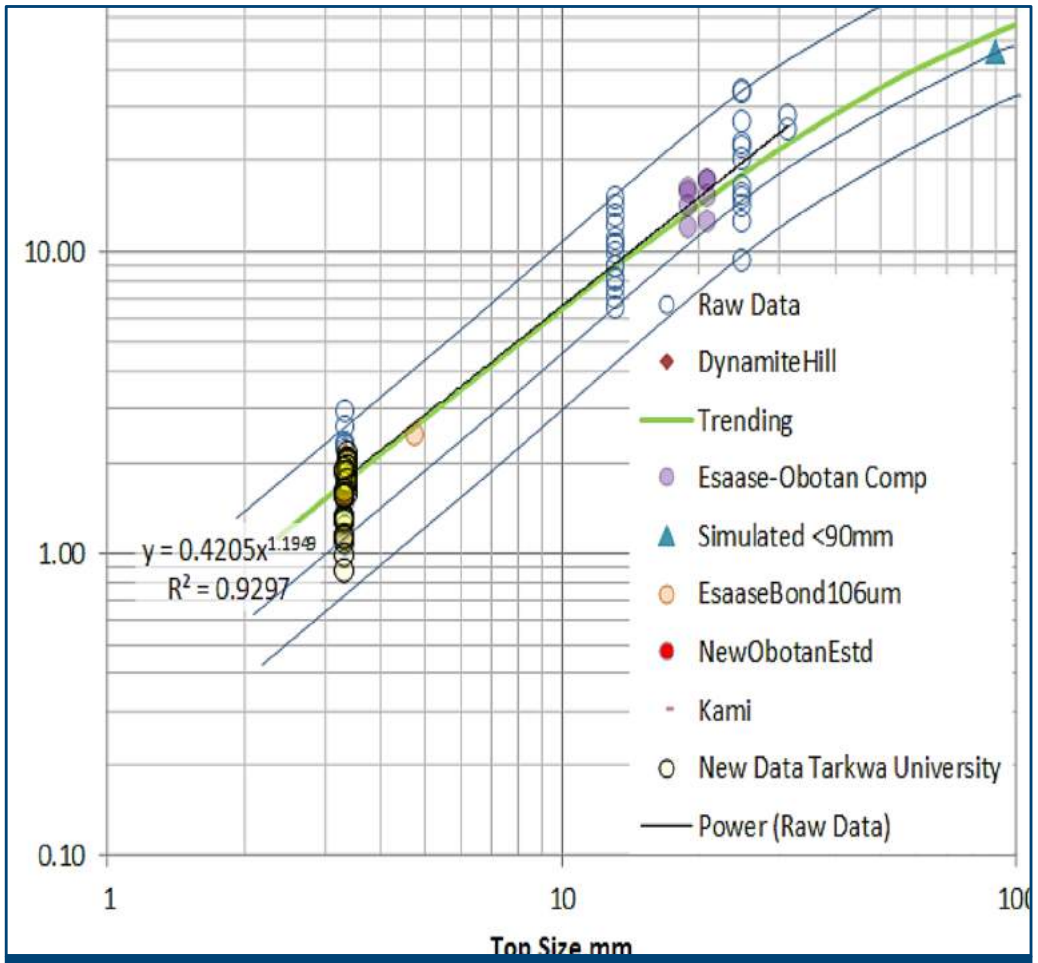
a) Toe angle reduces as mill starts to “fill” => the PID loop drops the tonnes, waits and starts to increase again as toe angle increases

b) Increased tonnage in a controlled manner

BWI & PEAK SPECIFIC BREAKAGE RATES INVESTIGATION



Nkran pit ore *Bond Ball Work Index (BWI)* sample population S-curve

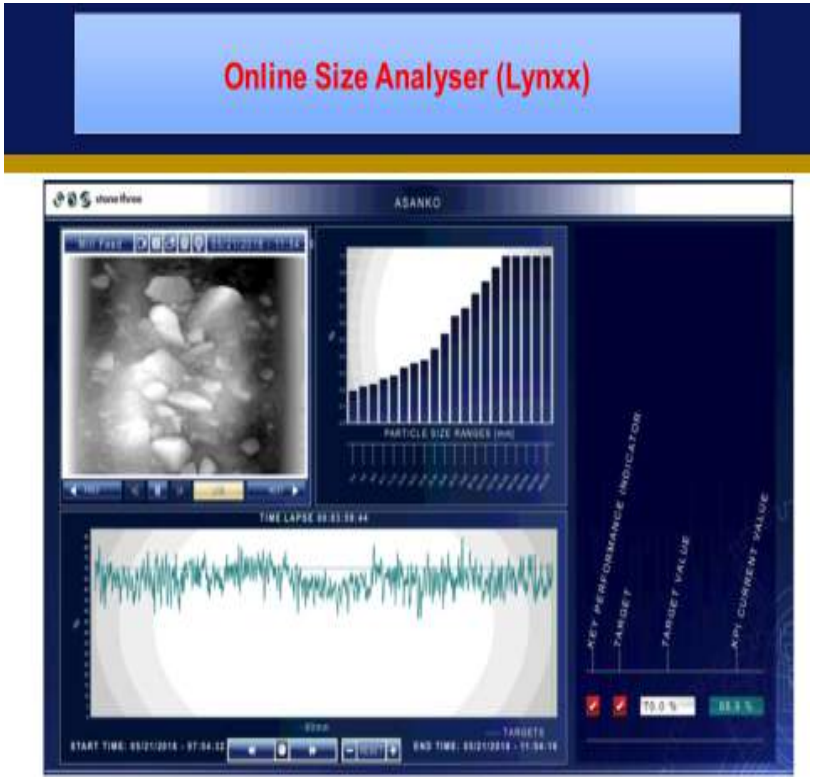


Variation in peak specific breakage rates (/t/kWh) in relation to top size (mm) for Asanko ores

GEOMET MODEL

- Comminution studies were undertaken to develop a Geomet milling model
- Peak Specific Breakage rate test was conducted
- Series of ball BWI tests to establish hardness of ore with depth and position within the pit
- Series of plant audits - Manuel belt cuts to establish fragmentation





GEOMET MODEL

Geomet formula includes:

- Fragmentation reporting to the SAG mill (% -80mm)
- Hardness (BWI) reporting to the SAG mill
- Thus simple formula that estimates potential feed capacity using hardness and fragmentation (% -80 mm)

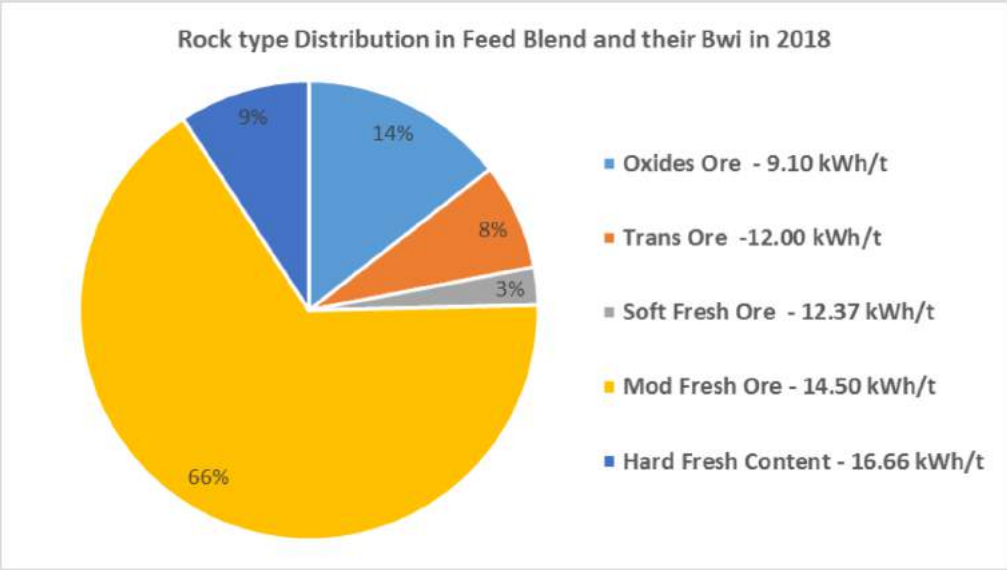
% -80mm	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	57	55
Wi, kWh/t																			
10.5	845	840	835	830	825	820	815	810	805	800	795	790	785	780	775	770	765	755	745
10.6	842	837	832	827	822	817	812	807	802	797	792	787	782	777	772	767	762	752	742
10.7	839	834	829	824	819	814	809	804	799	794	789	784	779	774	769	764	759	750	740
10.8	836	831	826	821	816	811	806	801	796	792	787	782	777	772	767	762	757	747	737
10.9	833	828	823	818	814	809	804	799	794	789	784	779	774	769	764	759	754	745	735
11.0	830	825	821	816	811	806	801	796	791	786	781	776	771	767	762	757	752	742	732
11.1	828	823	818	813	808	803	798	793	788	784	779	774	769	764	759	754	749	739	730
11.2	825	820	815	810	805	800	795	791	786	781	776	771	766	761	756	752	747	737	727
11.3	822	817	812	807	802	798	793	788	783	778	773	768	764	759	754	749	744	734	725
11.4	819	814	809	805	800	795	790	785	780	775	771	766	761	756	751	746	742	732	722
11.5	816	811	807	802	797	792	787	782	778	773	768	763	758	753	749	744	739	729	720
11.6	813	809	804	799	794	789	785	780	775	770	765	761	756	751	746	741	736	727	717
11.7	811	806	801	796	791	787	782	777	772	767	763	758	753	748	743	739	734	724	715
11.8	808	803	798	793	789	784	779	774	770	765	760	755	750	746	741	736	731	722	712
11.9	805	800	795	791	786	781	776	772	767	762	757	753	748	743	738	734	729	719	710
12.0	802	797	793	788	783	778	774	769	764	759	755	750	745	740	736	731	726	717	707
12.1	799	795	790	785	780	776	771	766	761	757	752	747	743	738	733	728	724	714	705
12.2	796	792	787	782	778	773	768	763	759	754	749	745	740	735	731	726	721	712	702
12.3	794	789	784	780	775	770	765	761	756	751	747	742	737	733	728	723	719	709	700
12.4	791	786	781	777	772	767	763	758	753	749	744	739	735	730	725	721	716	707	697
12.5	788	783	779	774	769	765	760	755	751	746	741	737	732	727	723	718	713	704	695
12.6	785	781	776	771	767	762	757	753	748	743	739	734	729	725	720	715	711	702	692
12.7	782	778	773	768	764	759	755	750	745	741	736	731	727	722	718	713	708	699	690
12.8	780	775	770	766	761	756	752	747	743	738	733	729	724	720	715	710	706	697	687
12.9	777	772	768	763	758	754	749	745	740	735	731	726	722	717	712	708	703	694	685
13.0	774	769	765	760	756	751	746	742	737	733	728	724	719	714	710	705	701	691	682
13.1	771	766	762	757	753	748	744	739	735	730	725	721	716	712	707	703	698	689	680
13.2	768	764	759	755	750	745	741	736	732	727	723	718	714	709	705	700	695	686	677
13.3	765	761	756	752	747	743	738	734	729	725	720	716	711	707	702	697	693	684	675
13.4	763	758	754	749	745	740	735	731	726	722	717	713	708	704	699	695	690	681	672
13.5	760	755	751	746	742	737	733	728	724	719	715	710	706	701	697	692	688	679	670
13.6	757	752	748	743	739	735	730	726	721	717	712	708	703	699	694	690	685	676	667
13.7	754	750	745	741	736	732	727	723	718	714	**709**	705	701	696	692	687	683	674	665
13.8	751	747	742	738	733	729	725	720	716	711	707	702	698	693	689	685	680	671	662
13.9	748	744	740	735	731	726	722	717	713	709	704	700	695	691	686	682	678	669	660
14.0	746	741	737	732	728	724	719	715	710	706	701	697	693	688	684	679	675	666	657
14.1	743	738	734	730	725	721	716	712	708	703	699	694	690	686	681	677	672	664	655
14.2	740	736	731	727	722	718	714	709	705	701	696	692	687	683	679	674	670	661	652
14.3	737	733	728	724	720	715	711	707	702	698	694	689	685	680	676	672	667	659	650
14.4	734	730	726	721	717	713	708	704	700	695	691	687	682	678	673	669	665	656	647

ROCK TYPES FEED DISTRIBUTION

Geo Met Model Production Planning

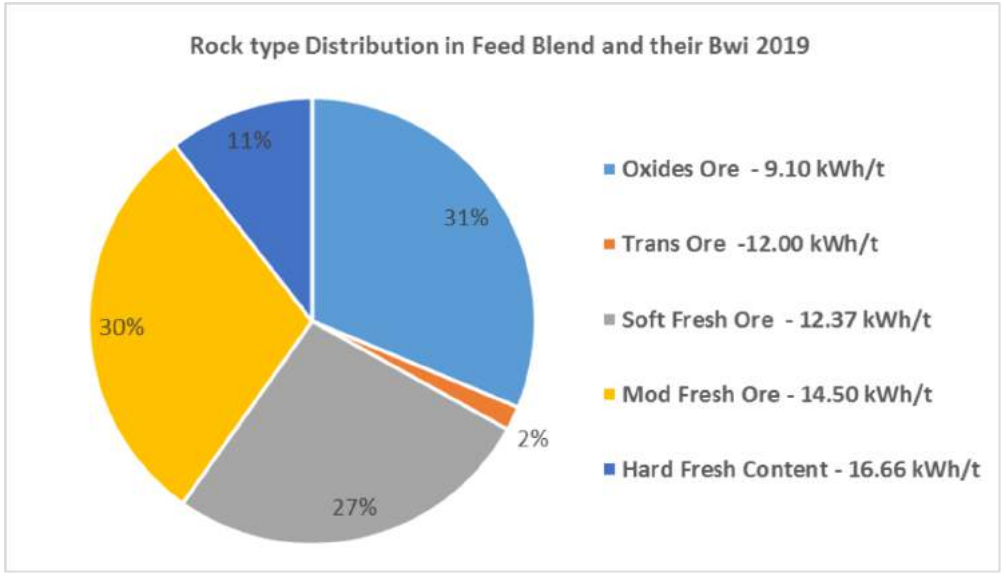
Rock Type Distribution in Feed Blend 2018

Avg BWI 13.67Kwh/t

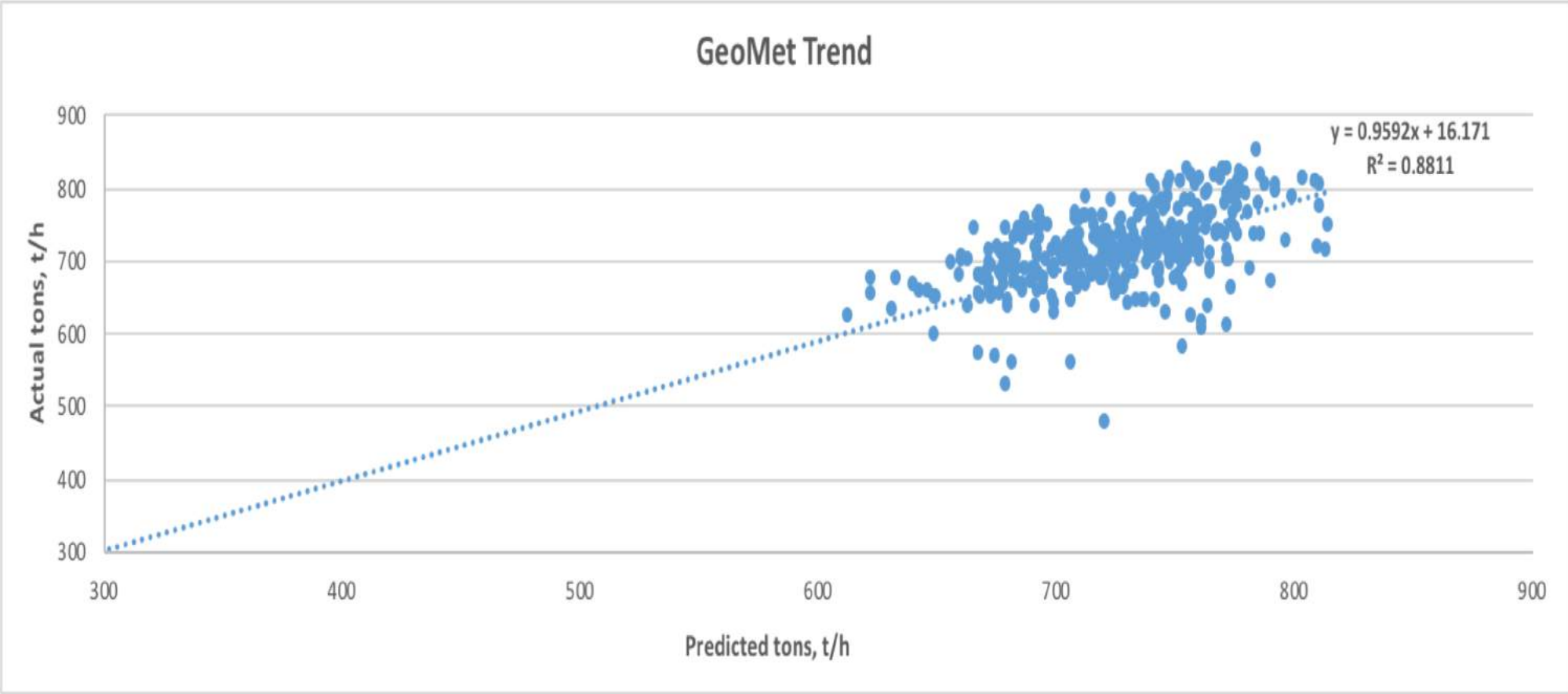


Rock Type Distribution in Feed Blend 2019

Avg BWI 12.42Kwh/t

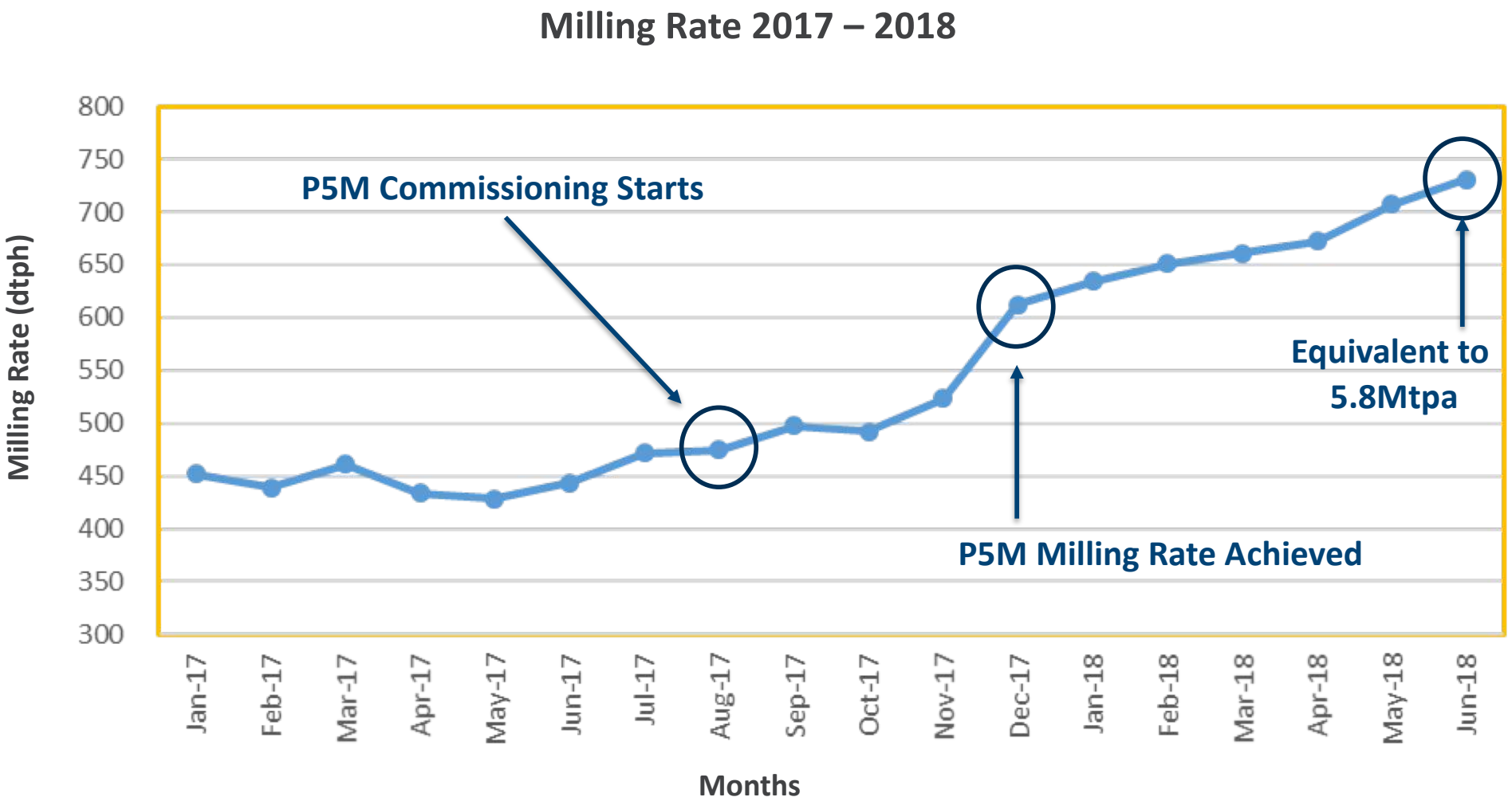


RESULTS AND END PERFORMANCE



The Geomet model predictability has helped confirm our approach to achieving P5M and assists with our thinking around future milling performance

P5M PERFORMANCE



CONCLUSION

The Asanko Gold Mine processing facility's feed tonnage has increased from 3Mtpa to >5Mtpa by means of:

- ✓ A focused team approach
- ✓ Implementation of a geo-metallurgical treatment plan
- ✓ Installation of mill feed monitoring equipment (MillSlicer)
- ✓ Integration of a knowledge-based control strategy





