

TRANSFORMATIONAL FLOWSHEET: UNLOCKING ENERGY AND WATER SAVINGS

*Fisher Wang¹, Erich Dohm², Serhat Onol³, Evgeny Zhmarin¹, Drew Hobert²

¹Swiss Tower Mills Minerals AG
Haselstrasse 1, 5400 Baden, Switzerland
(*Corresponding author: fisher.wang@stmminerals.com)

²Eriez Flotation
1901 Wager Road, Erie, PA, USA

³Weir
Egtenrayseweg 9, 5928PH Venlo, Netherlands

ABSTRACT

Addressing the mining industry's growing concerns about energy and water consumption, Weir, STM Minerals, and Eriez Flotation have jointly developed the "Transformational Flowsheet" - an innovative solution for modern mineral processing plant design. This collaborative effort integrates cutting-edge technologies to optimize energy efficiency and minimize water usage. The proposed flowsheet consists of high-pressure grinding rolls (HPGRs) and coarse vertical stirred mills, replacing conventional SAG and ball mill circuits. Additionally, coarse particle flotation technology maximizes early rejection of barren particles, producing mineralized particles for downstream regrind using energy-efficient vertical stirred mills. This design enhances target metal recovery by reducing over-grinding losses and utilizing inert grinding media. Through joint development, this paper showcases the potential energy and water savings of the "Transformational Flowsheet" paving the way for sustainable and efficient mineral processing practices.

KEYWORDS

Mineral Processing Flowsheet, Energy Efficiency, Water Savings, HPGRs, Stirred Mill, Coarse Particle Flotation



INTRODUCTION

As mineral processing faces escalating operating costs, diminished head grades, and harder ores coupled with finer dissemination, the industry must explore sustainable and cost-effective solutions. However, the fundamental components of today's mineral processing flowsheets have remained largely unchanged for decades, relying on horizontal tumbling mills to achieve the desired grind size for subsequent recovery processes in conventional mechanical flotation cells. In light of mounting concerns over excessive energy and water usage in the mining industry, Weir, STM Minerals, and Eriez Flotation have collaboratively introduced a forward-looking flowsheet concept at the esteemed international SAG2023 conference. As illustrated Figure 1, this innovative approach integrates HPGRs, vertical stirred mills, and coarse particle flotation technologies into a unified flowsheet, aimed at modernizing mineral processing plant design and addressing sustainability concerns. This paper presents a conceptual copper-gold concentrator case study, providing a comparative analysis of flowsheet development, equipment sizing and selection, as well as mass-water-energy balances between the conventional grind-float flowsheet design and the proposed transformational flowsheet.



Figure 1 – Transformational Flowsheet - Weir/STM/Eriez Alliance

TECHNOLOGY REVIEW

HPGR TECHNOLOGY – WEIR

High Pressure Grinding Rolls 'HPGR' has become an industry standard in crushing and grinding of hard and competent ore applications with its energy efficiency, superior wear liner design and flexibility. Weir has more than 80 installations worldwide with their ENDURON® HPGR design, making them the leading manufacturer of HPGRs in mineral applications.

In HPGR grinding two counter rotating rolls are presented to each other by a hydraulic system. The coarsely crushed feed material, when passing through the grinding zone, exposed to very high (specific) pressures generated by the hydraulic system, approaching and exceeding the compressive strength of the rock. During this, a high ratio of size reduction is achieved as a result of inter-particle compression within a particle bed between the roll surfaces and not by contact crushing of only coarse particles as in conventional compression crushers (Figure 2) (Van der Meer F.P., 2010).

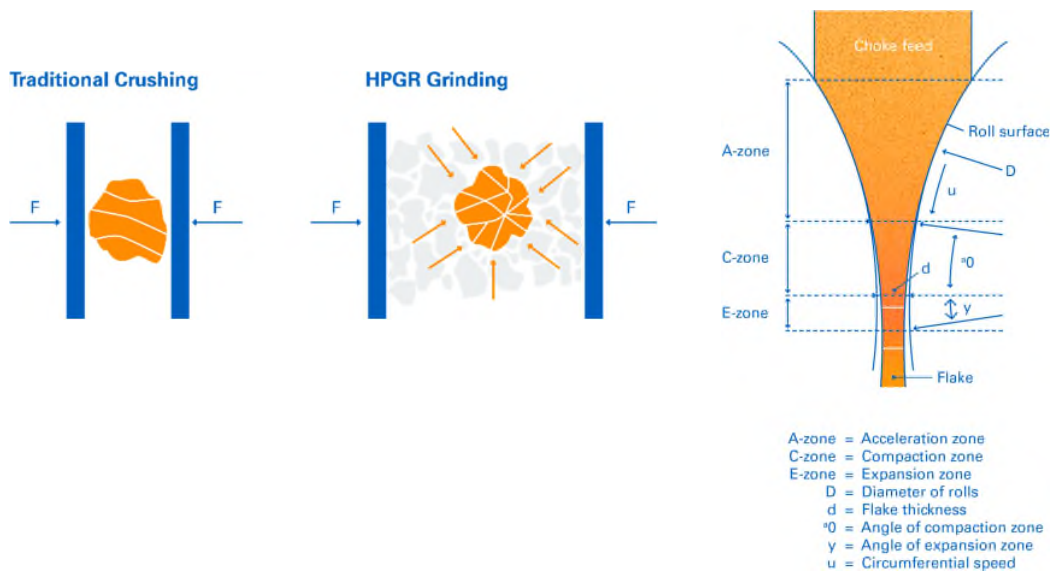


Figure 2 – Mechanism of Inter-Particle Crushing and HPGR Grinding

ENDURON® HPGRs operate in both dry and moist applications and can accept a wide range of feed material sizes. They mainly operate in closed circuit with dry/wet screening for product sizes up to around 2/3 mm, or in closed circuit with air classification for fine product size in the range of 80-120 microns. There are also a variety of applications where the HPGRs are installed and operate in open circuit, such as pebble crushing, and operate with partial product recycling (recirculation without screening) where the screening is not needed or not practical, such as gold heap leaching and pellet feed applications.

The ENDURON® HPGR design is well known for its high capacity, high availability and high flexibility. The HPGR roll surface is covered with high abrasive resistance tungsten carbide studs, which allows an autogenous wear layer to form. This layer is formed by embedding the compacted material in between the stud profiles, protecting the rolls from the abrasive feed material and increasing the wear life time well beyond a year of operation. Figure 3, illustrates the internal components of ENDURON® HPGR and the Studded roll surface.

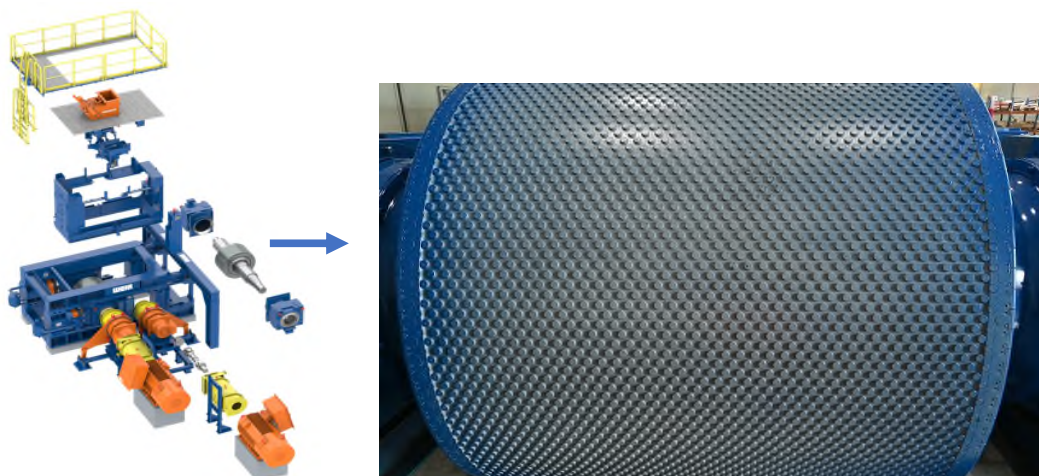


Figure 3 – ENDURON® HPGR Design and Roll Surface Lining

STIRRED MILL TECHNOLOGY – STM MINERALS

Swiss Tower Mill Minerals AG (STM Minerals) specializes in the design and manufacture of the state of art stirred milling technology, namely Vertical Power Mill (VPMmill™) and Vertical Regrind Mill (VRMmill™), for the mineral processing industry (Zhmarin et al., 2023).

Vertical Regrind Mills (VRMs) are highly energy efficient, which has well established for fine and ultrafine grinding of iron, copper, zinc, gold, molybdenum and platinum minerals in more than 50 projects throughout the global mining market, with many successful installations including AngloGold Ashanti's Sunrise Dam, Teck's Quebrada Blanca Phase 2 (QB2), and First Quantum's Cobre Panama, among many others. In 2023, STM has successfully delivered the largest operating VRM with an installed power of 6.5 MW in an iron ore processing plant in the USA. Additionally, STM has expanded the product range to a staggering 12.5 MW installed power for a single unit (Zhmarin et al., 2023).

Vertical Power Mills (VPMs), a more recent development, are designed specifically for coarse grinding applications and offer a viable energy efficient alternative to conventional horizontal ball mills in primary and secondary grinding duties (Paz et al., 2023). Extensive test work on coarse grinding has demonstrated the VPMs' ability to handle mill feed with a top size of 3-4 mm, making them suitable for processing product from a closed HPGR circuit (Vijfeijken et al., 2023).

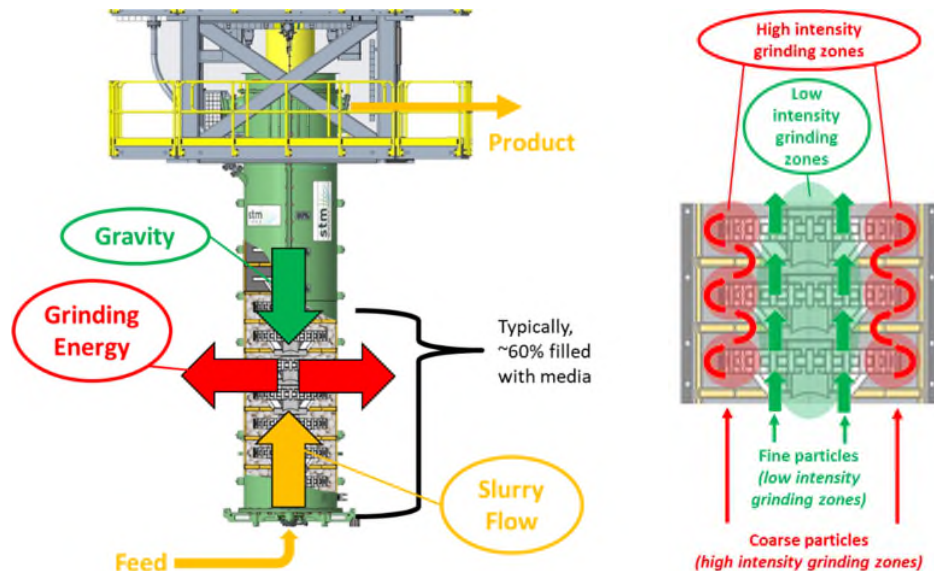


Figure 4 – Principle of STM mill Operation

Figure 4 illustrates the STM mills and their internal mechanisms. Grinding is achieved by attrition as feed particles interact with the ceramic grinding media. The mill's internal configuration includes shell liners and 360° stator rings positioned between each pair of grinding rotors, creating multiple grinding compartments in succession. This configuration supports coarser particles and ceramic media to move outward, driven by centrifugal forces, towards high-intensity grinding zones at the chamber's periphery. Meanwhile, finer particles ascend through the mill center, reducing the risk of overgrinding. This selective grinding mechanism, coupled with a variable-speed drive and the absence of short-circuit paths for coarse particles, enables an open-circuit approach, facilitating energy-efficient comminution.

FLOTATION TECHNOLOGY – ERIEZ FLOTATION

Coarse particle flotation is an emerging process in base metal and precious metal industries that offers substantial benefits for increasing plant throughput, maximizing mineral recoveries, and improving tailings and water management. Eriez Flotation is the world leader in coarse particle flotation with the HydroFloat® CPF technology, which has been established for more than 20 years as the standard flotation process for coarsely liberated minerals such as phosphate, potash, and lithium. There are several copper mining operations that already installed the HydroFloat® CPF technology, including Newmont's Cadia Valley Operation (Vollert et al., 2019) and Anglo American's El Soldado concentrator (Arburo et al., 2022). Furthermore, the HydroFloat® CPF technology is currently at various stages of evaluation for most of the largest copper mines in the world, including Rio Tinto's Kennecott Utah Copper operations (Hobert et al., 2023).

The HydroFloat® CPF technology is a fluidized-bed flotation technology that overcomes the turbulence and buoyancy constraints present in traditional flotation technologies, as summarized by Mankosa et al. (2016). In this device, shown in Figure 5, flotation is conducted under plug-flow conditions in the presence of a fluidized bed and up-current water flow, and absence of a traditional froth phase, to maximize the recovery of coarse and partially liberated particles typically lost using conventional flotation methods. As documented by Miller et al (2015), HRXMT data suggest targeted particles with as little as 1% exposed grain surface area are recoverable using HydroFloat® CPF technology. The HydroFloat® CPF technology has been successfully implemented in the copper industry on an industrial-scale for Tailings Scavenging (TS), treating rougher/whole tailings, and for Coarse Gangue Rejection (CGR), treating a fraction of the primary mill recirculating load, to recover particles two to three times coarser in size than recoverable in conventional stirred-tank flotation cells. This ability enables coarsening of the primary grind size, increasing throughput and reducing SAG-BM circuit power consumption (Pyle et al, 2022) and/or improvements in global metal recoveries. A comparative study of both TS and CGR applications at Capstone's Cozamin concentrator was reported by Regino et al (2020).



Figure 5 – Eriez HydroFloat® CPF-300 (left) and StackCell® SC-200 (right)

High-intensity flotation technology focuses energy input to enhance ultrafine particle recovery and improve flotation kinetics over the range of conventional flotation feed sizes. Through multiple full-scale installations and pilot-scale trials in base metals, Eriez' StackCell® high-intensity flotation technology has been proven to reduce flotation residence time requirement by 75-85% and increase fine particle recovery compared to conventional flotation cells (Wasmund et al., 2019). For example, an equivalent 600 m³ of flotation capacity was added to Newmont's Red Chris concentrator rougher

flotation circuit by installing two 65 m³ StackCell SC-200 cells (Seaman et al., 2021). Additional benefits of the StackCell® high-intensity flotation technology include a reduction in energy consumption as well as reductions in plant height, footprint and foundation loads (Mankosa et al., 2018). The novel, patented StackCell® technology de-couples the particle collection process from the froth recovery process, thus allowing for optimization of each process independently. In this device, depicted in Figure 5, pulp and air are introduced to the bottom of the StackCell contacting chamber through the feed inlet and air inlet. The pulp and air are subjected to intense mixing while traveling up through the contacting chamber and the mixture is discharged into a quiescent separation chamber to allow for a phase separation to occur between the pulp and froth. The froth depth is maintained sufficiently deep to facilitate froth washing, thus minimizing the entrainment of fine hydrophilic gangue.

PROJECT BACKGROUND – CONCEPTUAL CASE STUDY

For this study, the battery limits extend from the Run-of-Mine (ROM) feed to the primary crushing to the rougher tailings discharge (final tailings) and concentrate regrind circuit product. Cleaning / scavenger flotation, final concentrate handling, and final tailings management facility are excluded. To ensure a fair comparison between the two flowsheet designs, a summary of the key process parameters as the design basis is presented in Table 1, which is critical in determining the equipment sizing and selection for respective comminution and flotation technologies.

Table 1 – Summary of Key Process Design Criteria

Description	Unit	Values
Plant Throughput	tpd / tph	20,000 / 906
Plant Availability	%	92
Plant Feed Grade, Cu	%	0.4
Plant Feed Grade, Au	g/t	0.5
Materials Specific Gravity	t/m ³	2.7
Drop Weight Parameter Axb	-	40
Bond Ball Mill Work Index	kWh/t	18
Primary Grind Size	microns	150
Conventional rougher mass pull	%	10
Regrind Size	microns	30

FLOWSHEET DEVELOPMENT

BASELINE FLOWSHEET

The baseline flowsheet, employing conventional technologies and processes, is illustrated in Figure 6. Run-of-Mine (ROM) ores are fed to the primary crushing, subsequently the crushed ores report to the SAG milling in a closed circuit with a pebble crusher. Product from the SAG mill circuit (screen undersize) proceeds to the closed ball mill circuit before entering rougher flotation, followed by regrinding and cleaner flotation to yield a final concentrate. Rougher flotation uses conventional mechanical tank cells with a target feed size P80 of 150 microns, with subsequent regrinding to achieve a final grind size P80 of 30 microns for the cleaning/scavenging flotation. Flotation tailings are directed to a conventional wet tailing storage facility.

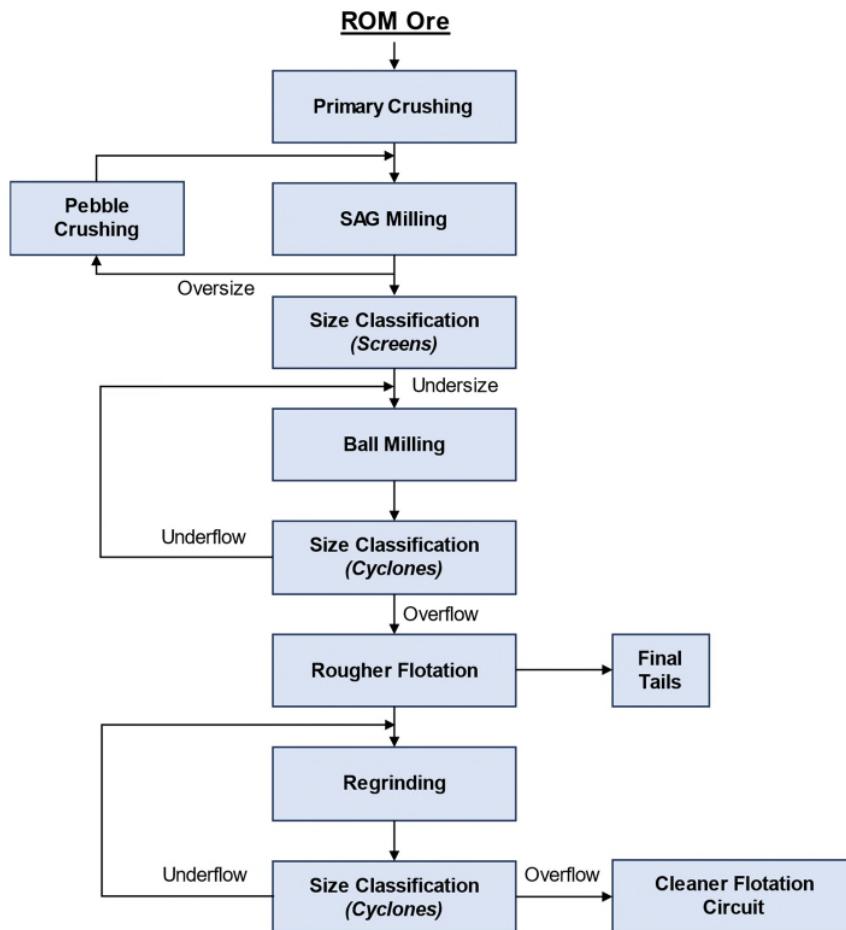


Figure 6 – Baseline flowsheet

TRANSFORMATIONAL FLOWSHEET

With the aim of minimizing energy and water usage, the proposed "Transformational Flowsheet" incorporates HPGR comminution, coarse and fine vertical stirred milling, coarse particle flotation, and high-intensity fine particle flotation. The schematic representation of this innovative flowsheet is presented in Figure 7.

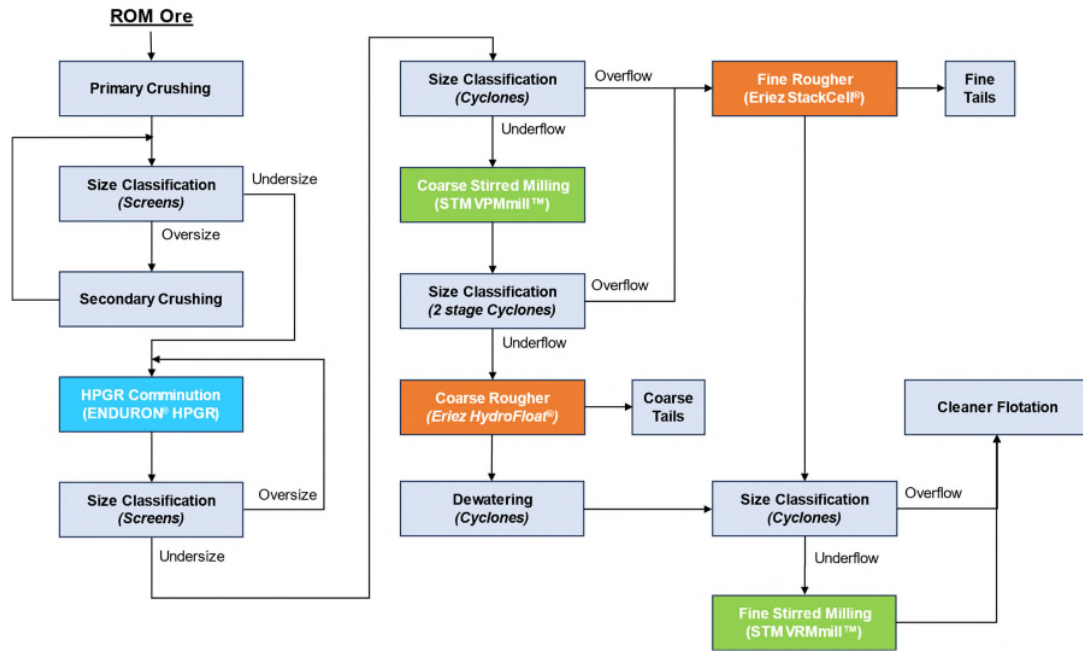


Figure 7 – Transformational Flowsheet

The ROM ores are fed to the primary crusher, with the crushed product directed to the closed-circuit secondary crushing circuit. The vibrating screen is used to remove fines ahead of the secondary cone crusher. The screen undersize is then sent to the HPGR circuit, which operates in a closed circuit with wet screens. The HPGR is configured to receive feed size F80 of ~50 mm and produce a screen undersize product P80 of 3 mm. The HPGR circuit product (screen undersize) is directed to hydrocyclones to remove fraction finer than 106 micron which can be fed directly to the fine rougher circuit, while the truncated product (cyclone underflow) proceeds to the STM's VPM in open circuit for coarse particle milling. The selection of coarse stirred mill grinding (VPM) in this study aims to streamline size classification processes while enhancing energy efficiency and water recovery.

The VPM mill product is classified using two-stage hydrocyclones at 106 microns. The fraction finer than 106 microns (cyclone overflows) is combined with the primary cyclone overflow, and then reports to high-intensity fine rougher flotation (e.g., the StackCell® unit), while the fraction larger than 106 microns goes to coarse rougher flotation (e.g., the HydroFloat® unit). The overall mass split for the fine and coarse circuits is roughly 50%. It is assumed that the fine rougher flotation requires a 10% mass pull to produce rougher concentrate at P80 of ~74 microns, while the HydroFloat® CPF concentrate mass pull is set at 30%, resulting in 136 tph CPF concentrate at 350-400 microns.

The combined concentrate from the fine rougher and coarse rougher flotation is directed to the regrind circuit, which comprises regrind cyclones followed by STM's vertical regrind stirred mill (VRM), operating in an open circuit. The total regrind throughput amounts to 158 tph with a weighted average P80 of 300 microns, requiring further grinding to achieve the final target grind size of 30 microns (same as the baseline).

EQUIPMENT SIZING AND SELECTION

In addition to the base process parameters outlined in Table 1, the “Transformational Flowsheet” would consider additional process parameters. The updated process design criteria for the proposed flowsheet is shown in Table 2.

Table 2 Summary of Key Process Design Criteria - Transformational Flowsheet

Description	Unit	Values	Remarks
Drop Weight Parameter Axb	-	40	Same as baseline
Bond Ball Mill Work Index	kWh/t	18	Same as baseline
HPGR specific throughput mdot	ts/hm ³	TBD	Weir database
HPGR SGE (Specific Grinding Energy)	kWh/t	1.80	Weir simulation
Coarse Stirred Mill SGE	kWh/t	4.5	STM database
Primary Grind Size	microns	300	Typical 2x baseline
CPF Coarse Rougher Mass Pull	%	30	Eriez database
Fine Rougher Mass Pull	%	10	Same as baseline
Regrind Size	microns	30	Same as baseline
Fine Stirred Mill SGE	kWh/t	18	STM database

Table 3 present a list of the major process equipment selected for the baseline flowsheet and the transformational flowsheet, including equipment quantity, installed power and operating specific energy (relative to the ROM feed). The sizing considerations are described in the following sections.

Table 3 – Major Equipment: Baseline Flowsheet vs. Transformational Flowsheet

Description	Baseline			Transformational Flowsheet		
	Qty	Installed, kW	SE, kWh/t	Qty	Installed, kW	SE, kWh/t
Primary Crushing	1x Gyratory	300	0.23	1x Gyratory	300	0.23
Secondary/Pebble Crushing	1x Cone	300	0.26	1x Cone	600	0.53
Primary Grinding	1x SAG mill	9,000	8.54	1x HPGR	4,000	3.66
Secondary Grinding	1x Ball mill	9,000	8.54	1x VPM50	5,000	4.50
Rougher Flotation	7x 100 m3 Tankcell	770	0.59	6x SC-50 (fine)	330	0.25
				2x CPF-200 (coarse)	75	0.06
Regrind	1x Ball mill	2,000	1.90	1x VRM23000	3,500	3.59

HPGR SIZING CONSIDERATION – WEIR

Sizing of the ENDURON[®] HPGR is based on the specific ore parameters and the throughput of the comminution circuit. Weir conducted simulations based on the material specific model developed after testing and run scale-up for the equipment as well as its drive train according to the design criteria for this conceptual flowsheet. Resulting particle size distributions are given in Figure 8. With a specific energy of 1.8 kWh/t, the overall net consumption at HPGR stage would be around 3.67 MW.

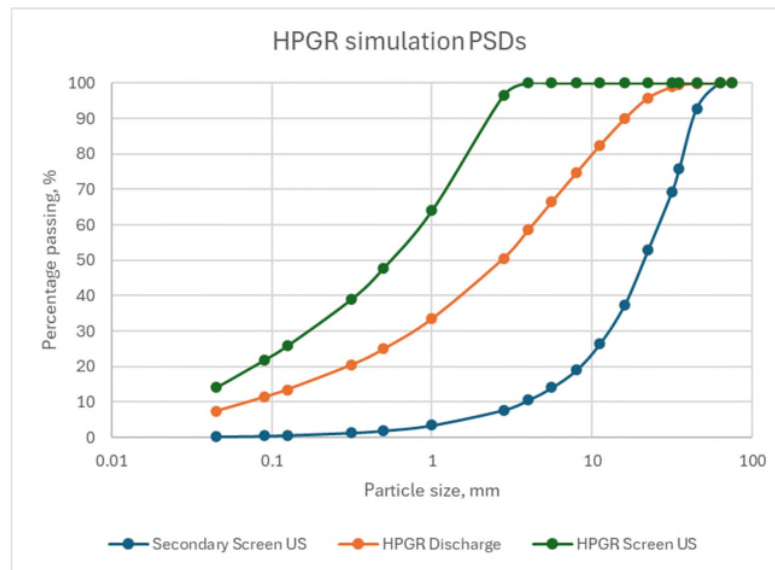


Figure 8 – HPGR simulation PSDs

COARSE AND FINE STIRRED MILLING SIZING CONSIDERATION – STM MINERALS

For the coarse grinding (secondary grinding circuit), it would be advantageous to conduct actual grinding tests on materials prepared by HPGR using a large pilot VPM unit (e.g. VPM0.3) to obtain parameters for mill sizing and performance evaluation. Based on extensive test campaigns, STM achieved savings ranging from 20% up to 40% in the VPMs compared to conventional ball mills for similar grinding duties. At this conceptual stage, STM opted for a more conservative estimate of 20% for VPM sizing and selection.

For the fine grinding (regrind circuit), while fluidized stirred media mills are known for their improved energy efficiency compared to conventional ball mills, resulting in additional savings in specific energy consumption, the overall installed and operating power for the regrind circuit in the transformational flowsheet would still be higher than that of conventional regrind circuit with horizontal ball mill in the baseline flowsheet. This difference is due to the increased rougher concentrate mass rate from the coarse and fine rougher flotation circuit, and augmented grindability owing to the presence of harder and more competent particles. At this conceptual stage, STM selected a specific grinding energy based on its extensive testing database for similar ore type and grinding duty.

COARSE AND FINE PARTICLE FLOTATION SIZING CONSIDERATION – ERIEZ FLOTATION

Sizing of the HydroFloat® CPF circuit is based on the tonnage of feed solids to the HydroFloat® CPF, as well as the feed size distribution and solids specific gravity. For this future flowsheet application, two HydroFloat® CPF-200 units were selected. In addition to the equipment size, metallurgical performance for the HydroFloat® CPF technology must be established through metallurgical testing, which includes evaluation of grind size, reagent chemistry, feed conditioning, fluidization water rate, air rate, and fluidized bed level. Eriez' metallurgical testing approach provides robust scale-up from laboratory to pilot-scale to commercial-scale performance (Hobert et al., 2023). Typically, metallurgical performance investigations begin with laboratory scoping studies to assess amenability of ore samples to coarse particle flotation. These studies may include mineralogical analysis, lab-scale HydroFloat® CPF testing, and downstream milling and cleaner flotation studies to confirm the grade/recovery response of the ore at different grind sizes. Preliminary estimates of HydroFloat® CPF metallurgical performance and operational parameters can be derived from historical data in the absence of metallurgical test results.

For the StackCell® high-intensity flotation circuit, equipment sizing is primarily based on residence time requirements and froth carrying rate limitations. For this future flowsheet application, six StackCell® SC-50 units were selected. Metallurgical performance of the StackCell® high-intensity flotation technology is established through laboratory and/or pilot-scale investigations to define the grade/recovery response of a given ore. Such investigations generally include evaluation of the flotation kinetics using a conventional mechanical laboratory flotation cell to establish baseline performance, followed by evaluation of the effect of lower feed density and wash water on the grade/recovery response. Pilot-scale investigations of the StackCell® high-intensity flotation technology are executed using 250-liter StackCell® units capable of processing up to 25 m³/h of feed slurry in a continuous steady-state test environment. The scale-up of the StackCell® metallurgical results has proven to be extremely reliable using these approaches and provides an opportunity to evaluate the technology and optimize circuit design in early stages of flowsheet development.

ENERGY AND WATER BALANCE

For the study, mass and water balances were developed for each flowsheet option, as illustrated in Figure 9 and Figure 10. As outlined in Table 4, the proposed flowsheet yielded a 36% reduction in energy consumption based on per tonne of wet ore processed. However, detailed study of auxiliary equipment energy consumption has not been conducted for either flowsheet. Regarding water consumption, the proposed flowsheet reduced from 0.48 m³/t to 0.24 m³/t, marking a 50% reduction mainly attributed to improved water recovery thanks to CPF coarse tailings production.

Table 4 – Energy and Water Consumption – Baseline Flowsheet vs. Transformational Flowsheet

Description	Unit	Baseline	Transformational Flowsheet	Difference relative to baseline
Energy consumption	kWh/t ore	20.1	12.8	-36%
Water Consumption	m ³ /t ore	0.48	0.24	-50%

CONCLUSIONS AND RECOMMENDATIONS

Efforts to support sustainability in the mining sector are increasingly focused on reducing energy and water usage while optimizing resource utilization. A range of technologies has emerged over the past decades to advance sustainable practices, including energy-efficient comminution methods like HPGR and stirred mills, as well as coarse particle flotation and high-energy intensity flotation technology. Weir, STM Minerals, and Eriez Flotation are committed to developing innovative mineral processing flowsheet designs incorporating each company's core technologies to support industry-wide efforts to reduce carbon emissions and operational costs. In this paper, the proposed "Transformational Flowsheet" is compared to conventional SABC and flotation circuits for a conceptual open-pit copper-gold mine, illustrating significant energy and water savings, along with the advantages of generating high-quality coarse tailings for enhanced tailings management.

Weir, STM Minerals, and Eriez Flotation are seeking collaboration with forward-thinking industrial leaders, to co-develop the proposed flowsheet that integrates HPGR, VPM/VRM, and CPF technologies into a cohesive system. We acknowledge that there is further work needed to validate and quantify the anticipated benefits in comparison to existing plant operations. Consequently, a comprehensive business case needs to be developed in collaboration with operations and others to promote this innovative flowsheet concept widely across the industry.

REFERENCE

- Arburo, K., Zuniga, J., McDonald, A., Valdes, F., Concha, J. and Wasmund, E., 2022. Commissioning a HydroFloat in a Copper Concentrator Application, Copper 2022 Conference, Santiago, Chile.
- Hobert, A., Van Wagoner, R., Dohm, E. and Byrd, T., 2023. Industrial Demonstration of Coarse Particle Flotation at Rio Tinto Kennecott, Procemin-Geomet 2023: 19th International Conference on Mineral Processing and Geometallurgy, Santiago, Chile.
- Johansson, M., Zhmarin, E., Wang, F., & Olsson, J. (2024). Assessment of the feasibility of crushing and vertical stirred milling as a complete comminution solution. 56th Annual Meeting of the Canadian Mineral Processors, Ottawa, ON, Canada.
- Mankosa, M., Kohmuench, J., Christodoulou, L. and Luttrell, G., 2016. Recovery of Values from a Porphyry Copper Tailings Stream, IMPC 2016: XXVIII International Mineral Processing Congress, Quebec City, Canada.
- Mankosa, M., Kohmuench, J., Christodoulou, L. and Yan, E., 2018. Improving Fine Particle Flotation using the StackCell (Raising the Tail of the Elephant Curve), Minerals Engineering, Volume 121, pp. 83-89.
- Miller, J., Lin, C., Wang, Y., Mankosa, M., Kohmuench, J. and Luttrell, G., 2016. The Significance of Exposed Grain Surface Area in Coarse Particle Flotation of Low-Grade Gold Ore with the HydroFloat Technology, IMPC 2016: XXVIII International Mineral Processing Congress, Quebec City, Canada.
- Paz, A. Z. (2023). Recent developments in coarse grinding using vertical stirred mills. In The 13th International Comminution Symposium. Cape Town.
- Pyle, L., Valery, W., Holtham, P. and Duffy, K., 2022. Pre-Concentration – More than Bulk Ore Sorting, IMPC 2022: XXXI International Mineral Processing Congress, Melbourne, Australia.
- Regino, R., Wong, H., Lopez, O., Adams, K., Hobert, A. and Wasmund, E., 2020. Comparison of Two Circuit Applications for Implementation of Coarse Particle Flotation, 59th Annual Conference of Metallurgists, Canadian Institute of Mining, Metallurgy and Petroleum.
- Seaman, D., Li, K., Lamson, G., Seaman, B. and Adams, M., 2021. Overcoming Rougher Residence Time Limitations in the Rougher Flotation Bank at Red Chris Mine, 15th Mill Operators Conference, Australasian Institute of Mining and Metallurgy.
- Van der Meer F.P. (2010) High Pressure Grinding Rolls Scale-Up and Experiences. Proceedings XXV IMPC 2010, Brisbane pp1319-1331
- Wasmund, E., Thanasekaran, T. and Yan, E., 2019. A High Rate Mechanical Flotation Cell for Base Metal Applications, 10th International Copper Conference, 58th Annual Conference of Metallurgists, Canadian Institute of Mining, Metallurgy and Petroleum.
- van de Vijfeijken, M., Dierx, B., Wasmund, E., Concha, J., Hernandez, J. and Sherman, M., 2023. Flowsheet of the Future: High-Pressure Grinding Rolls, Vertical Stirred Mill, Coarse Particle Flotation, Vertical Stirred Regrind Mill. In International Conference on Semi-Autogenous Grinding & High Pressure Grinding Technology, Vancouver, Canada.
- Vollert, L., Akerstrom, B., Seaman, B. and Kohmuench, J., 2019. Newcrest's Industry First Application of Eriez HydroFloat Technology for Copper Recovery from Tailings at Cadia Valley Operations, Copper 2019 Conference, Vancouver, Canada.

Zhmarin, E., von Känel, D., Rodej, P., Erschewski, A., and Andrade, C., 2023. Extending STM's Large Vertical Stirred Mill Portfolio up to 12.5 MW. In International Conference on Semi-Autogenous Grinding & High Pressure Grinding Technology, Vancouver, Canada.