NEW PRODUCT ANNOUNCEMENT, by Starkey & Associates Inc. Oakville, ON. August 10, 2020

Lab-Scale Continuous Semi-Autogenous (SAG) Grinding Mill

A Lab-Scale Starkey SAGDesign Pilot Plant Continuous Wet SAG Mill (Mini Pilot SAG Mill) has been developed by Starkey & Associates Inc. to fulfill a need in the mining industry to economically pilot test the grinding and beneficiation of every mining project, whether for a new open pit or underground mine, or for re-evaluation of producing properties.

The design of this Mini Pilot SAG Mill has been carefully documented to support a patent application which was filed on June 11, 2020. The first mill has been sold to Dr. Erin Bobicki and was delivered to the University of Toronto on January 2, 2020. A patent has been applied for because this development is a complete game changer for mineral and metallurgical process pilot plant testing in the mining industry.

Picture During Fabrication of SAG Mill (Chamber 488 mm (19.2 in) diameter by 163 mm (6.4 in) long for the University of Toronto

John Starkey (Inventor) at the Westpro Shop

The new Mini Pilot SAG Mill pictured above (under construction at Westpro's shop in Puslinch, ON), will be used by the University of Toronto to teach students the fundamentals of SAG mill operation and design, and also to perform on-line SAG mill grinding on client's ores, to confirm the size and power needed for commercial use, and also to prepare SAG ground ore for beneficiation testing in a pilot plant, without the need to store the ground ore prior to use in the mini-scale pilot plant.

Since SAG and AG grinding was introduced 70 years ago, it has been thought that pilot plant SAG grinding work needed to use F_{80}, 6 inch feed to be valid. SAGDesign batch testing technology (now in use for 15 years on every type of ore and size of SAG plant built), can successfully design grinding mills by testing 100% passing 1" ore (F80 = 0.75"), using readily available standard commercial split diamond drill core from diamond drilling, which is done to develop reserves on every mining project in the world.

A standard procedure in the industry has been to utilize a pilot scale SAG mill having a diameter of six feet and an effective grinding length of two feet. Such a pilot scale SAG mill is used to provide metallurgical recovery data, which is used in scale up for the design of a commercial size SAG mill. However, a pilot scale SAG mill having a diameter of about six feet processes up to about one tonne per hour of ore, and each test must be conducted for several days in order to obtain the data needed for scale-up calculations. Thus, a large quantity of coarse ore is presently required for any pilot plant grinding test. As any one sample of ore is not characteristic of the entire ore body, it is necessary to obtain and process numerous samples from the ore body, and many tons of each sample are needed. Because of this, most plants are designed and built without adequate design data. This in turn leads to costly mistakes and production shortfalls. In fact to start up an underground mine it is prohibitively expensive to obtain a coarse sample (minus 152 mm pieces) suitable for pilot plant SAG testing and as a result, only open pit mines can be properly tested before start-up, prior to this invention of a Mini Pilot SAG Mill.

One effective alternative used in the industry is the Starkey SAGDesign laboratory batch SAG mill having a diameter of 19.2 inches by 6.4 inches long, inside the grinding chamber. A SAG mill of this size requires only a small sample of ore, as half cut standard diamond drill core (15 kg of minus 1" ore is needed), and that is run as a batch lab test, not as a continuous pilot plant test. The batch Starkey SAG mill provides data on ore hardness, the specific gravity of the ore, and the projected SAG energy requirements in a large commercial SAG mill within plus or minus 5%, the most accurate SAG test available in the mining industry today. This is sufficient data for calculation and scale up of the size and power, of the grinding mills needed (SAG and ball mills), to a commercial size, when enough data is obtained to define the hardness variability functions for the ore body.

Looking ahead, the new continuous wet grinding (Mini Pilot SAG Mill), will also provide additional data that is useful for the design of commercial comminution circuits. In particular, the classification systems required to handle the recirculating loads in the grinding part of the commercial process plant will be much easier to design accurately. In addition, SAG ground feed to test the beneficiation processes, will be used to recover the mineral values, whether by flotation, leaching, gravity separation, or magnetic separation. This testing will reliably improve the financial accuracy and viability of the planned operations and improve the opportunity for the new process plant to work as intended. The mini pilot testing will also provide material to do downstream pilot plant testing on mineral concentrates, which is needed to physically test and recover the minerals and/or metals to be sold, and to demonstrate the purity of the mineral production that will in turn determine the value of the recovered metal in the marketplace.

Before today, meaningful pilot plant tests on SAG mill ground ore could not be obtained at reasonable cost from an underground deposit. In particular, minimal data on the grinding aspects of the operation of a commercial SAG mill treating underground-mined ore, were obtained. Thus, the designer of the commercial scale SAG mill and the downstream processes, was forced to make assumptions in the calculations, without actual pilot plant support data, and with no evidence on whether downstream metallurgical processes will respond in the manner predicted from pilot plant work that does not use the proper SAG milling continuous grinding process to prepare the ore as feed for the pilot plant test.

In North America today, the majority if not all of the metallurgical pilot plant testing by flotation, leaching, gravity and magnetic concentration, is done at a scale of about 10 to 100 kg per hour, with grinding preparation being done on finely crushed ore, in the range of 100% minus 1.7 mm to as coarse as minus 6 mm, followed by ball mill grinding of the crushed ore to the size required to liberate the mineral values. By omitting SAG grinding of this material, the opportunity to make serious process selection mistakes is increased, especially if excess SAG mill generated fines consume large quantities of reagents. The consequence of that is that a proposed commercial scale SAG mill may not have been properly sized or evaluated, and that the process so being built, may be wrongly sized and produce less valuable mineral concentrates than expected.

In addition to the quality of the grinding done in a research ore testing program without a SAG mill, the industry is also very aware of major design failures in new projects. These are often caused by owners accepting bids for undersized semi-autogenous grinding mills. The Patented Mini Pilot SAG Mill has been designed to prevent production losses from any cause, by using best practice technology for ore testing.

For organizations wishing to test their ore in this Mini Pilot SAG Mill, followed by mini-plant processing, please contact one of the following companies who have agreed to collaborate to provide this service which includes ore testing of any commercial diamond drill split core, analysis of results and process equipment sizing, and engineering of the process plant required to profitably recover the mineral values:

1. University of Toronto, Dr. Erin Bobicki, Adjunct Professor of Mineral Processing
2. Starkey & Associates Inc., Mr. John Starkey, Principal Consulting Engineer and President.

We expect more names to be added to this list in the near future, such as an engineering company and/or a commercial testing lab.

Prepared by:

John Starkey, BASc., P.Eng., FCIM
President.

August 10, 2020