PROCEEDINGS:
THE FALCON SEMI-BATCH GRAVITY CONCENTRATOR

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A brief overview of Sepro's FALCON SB concentrators is provided below as an aid to understanding the depth of knowledge and ongoing support behind Sepro's latest generation of batch-type concentration technology.

SECTION 1. OVERVIEW

SEPRO is a profitable, private company with substantial employee ownership. Financial success and dominant market share with our core FALCON technologies led to entry into other related businesses including mineral processing testwork and the manufacture of mineral dressing scrubbers and grinding mills. The first FALCON concentrator was constructed in 1982 and evaluated in a sand and gravel washing operation in Canada. Since then, Sepro's technology has continuously evolved and improved to meet the rigorous demands of today's mineral processing industry. Today, Sepro offers three distinct world-leading enhanced gravity concentration technologies for different applications:

FALCON Semi-Batch (SB) concentrators are specifically designed to recover precious metals that occur in the free, metallic state. This type of application requires very high concentrating ratios and consequently very small mass yields to concentrate, usually << 0.1%. Continuous Falcon Concentrators (C) are used in applications where a considerably higher mass yield than 0.1% is required. UF concentrators can break the 10 micron barrier for efficient mineral concentration based on physical principles. For example, testwork has shown them to be effective to about 3 Microns in Tin.

SECTION 2. GENERAL WORKING PRINCIPLES APPLICABLE TO 'SB' CONCENTRATORS

2.1. LAMINAR FLOW VS. TURBULENT FLOW

The bowl of a FALCON concentrator consists of a sophistically engineered system of two sections: The conical stratification zone [S]* and the vertical retention zone [R]*. Slurry is accelerated to reach a high centrifugal velocity and stratified along the steep, smooth wall under semi-laminar flow conditions. Stratification and acceleration are effective on the finest particle sizes in the industry. Pulp densities below 50-60% solids by weight are most favourable. The laws of physics (and common sense) dictate that separations become more inhibited as pulp density increases. Although it is possible to treat up to 70% solids by adding fluidizing water and providing a bowl with riffles from top to bottom, this approach introduces turbulence and results in loss of fine target minerals. It is clearly understood that laminar flow characteristics are superior to turbulent for gravity recovery of fines. Falcon Concentrators have been repeatedly proven to be the world's best concentrator for recovery of fines.

2.2. CONCENTRATE RETENTION

The FALCON Concentrator is the only device that combines two principles of concentrate retention: The unfluidized retention [R1]* of a stratified layer (at the end of the laminar flow stratification zone [S])* and the concentration by embedment in a fluidized bed [R2]*. Particle size has an influence.

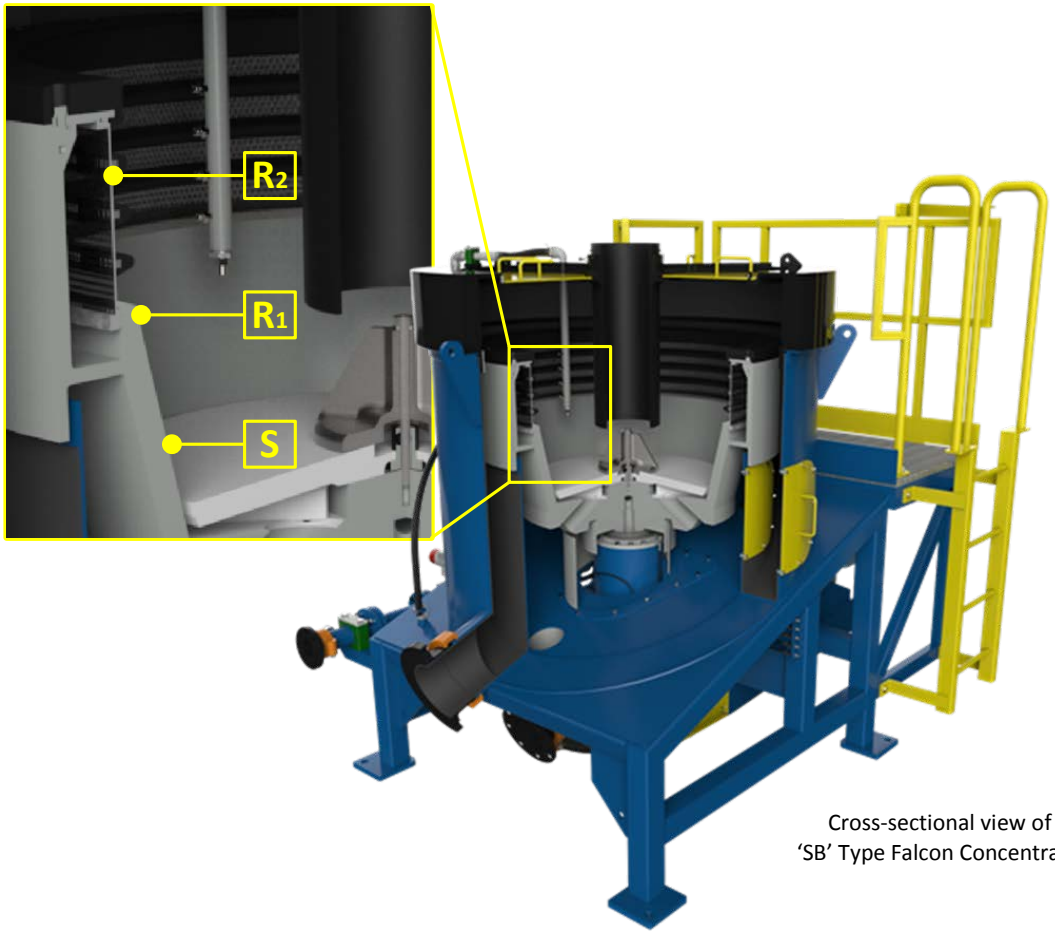
Fine particles can be retained in voids but do not penetrate a fluidized bed by replacing lighter and generally coarser particles. Fines are retained in the unfluidized zone after sufficient stratification and acceleration of the flowing film has been accomplished.

Coarse particles roll over the “beach” of concentrated fines in the unfluidized zone due to a high exposure to drag until they reach the fluidized bed in which they are embedded. The water flow into the fluidized retention zone of uniform dimensions can precisely be controlled. The competitors approach involves a series of staggered riffles not allowing for stratification of fines but creating turbulence which in turn aids in loosening the bed and embedding coarse particles but suffers efficiency in the recovery of fines. The balancing act of fines and coarse recovery is mastered combining Falcon’s two retention principles.
* Please refer to the following figure

2.3. G-FORCE & DRIVE SYSTEM

FALCON concentrators are supported by rugged frames and also highly advanced and reliable bearing design that together allow for centrifugal acceleration of up to 200G. The benefits from elevated G-Force are specifically promoted with the semi-laminar flow component in FALCON’s two stage bowl design.

The machines utilize a VFD (Variable Frequency Drive) to control the bowl speed and centrifugal acceleration. Dynamic braking absorbs the energy of the rotating bowl from run speed to rinse speed, allowing for rapid rinse cycles, shorter offline times or in turn longer online time.



Cross-sectional view of the
‘SB’ Type Falcon Concentrator

SECTION 3. SB FLUIDIZATION WATER & OPERATING COSTS

3.1. WATER CONSUMPTION

Clean high quality fluidization water is required to operate fluidized bed-type centrifugal gravity concentrators. The flow is controlled by the process automation system and water is injected through small holes into the fluidized concentrate bed. The water consumption of a FALCON Model SB5200 is 25-35 m3/h, while the competitor's similarly sized model is specified to consume 28-86 m3/h, a significantly costly difference of over 200.000 m3 of high quality water per year (8000 op.hr.) in favour of FALCON's technology. FALCON's two-stage bowl guarantees water utilization at the most effective point, halving the water consumption of the competitor.

3.2. HOLE DESIGN

The holes through which water is injected in the FALCON are short, relatively large in diameter and radially drilled, whereas competitive design is based on longer and smaller holes, drilled almost tangentially. The material through which the holes are drilled is also important. With the FALCON design, the material selected is stainless steel that is highly resistant to particle embedment. Soft polyurethane allows solids to embed themselves in the hole walls and become stuck. This combination of features means that a FALCON will require substantially less service compared to the competition.

SECTION 4. WEAR & OPERATING COSTS

4.1. LSP* WEAR IMPROVEMENT (DETOUR LAKE GOLD)

FALCON's strategy to combat wear and reduce operating costs is based on a zoned approach. The impeller, lower strike point and lip ring are the major wear parts and are not recovery related. The concentrate retention zone [R] is basically not wear affected. Wear items are separate exchangeable parts as opposed to the competitor's philosophy of supplying costly complete bowls through an exchange program. In their machine, the turbulent passage of slurry abrades the staggered series of riffles causing recovery to decrease constantly until the day the whole bowl is replaced. On the other hand, Sepro's dedication to lowering operating costs through continuous improvement includes many facets. One of many ongoing initiatives is the introduction of LSP inserts at one of Canada's largest gold mines. The LSP insert has recently (2014) been provided to the Detour Lake Mine to improve operating costs and mechanical availability in the face of extremely abrasive ore:

> "Detour Gold ore has extremely aggressive wear characteristics for our processing equipment and piping, so we originally specified ceramic tile lining in our SB5200B Falcon Concentrators and associated piping. Sepro offered to develop an improved rotor bowl lining system to help extend wear life and reduce operating costs. The resulting molded rubber Lower Strike Point (LSP) Insert ring is lasting about 1.5 – 2 times longer than the original ceramic tiles and knocks into place without removing the bowl. It effectively relines the lower bowl impact wear area very quickly and has demonstrated significant improvement in wear and reduced maintenance costs."
> - Gerry Barstad, Chief Metallurgist - Detour Gold Inc.

As a result of the success of the LSP insert (LSPI) at Detour Lake, it has become standard on all new SB5200's. LSPI's can also be retrofitted into the existing fleet of almost 200 SB5200 machines.

* Lower Strike Point

SECTION 5. PERFORMANCE & DELIVERY

5.1. PERFORMANCE (EXAMPLE POLYUS)

Sepro Mineral Systems has proven to be a competent partner for projects ranging from the smallest to the largest. Polyus Gold is the biggest gold producer in the CIS group of countries and operates the Natalka project which is their most recent and largest gold project. Polyus exclusively utilizes FALCON concentrators at Natalka (13 x Falcon SB5200 units and 2 x Falcon SB2500 units) as part of an extensive gravity system including screens, pumps, intensive leach, electro-winning and smelting equipment, engineered and supplied by Sepro.

5.2. DELIVERY AND PERFORMANCE (EXAMPLE PHONESACK)

Sepro has recently completed the EXW supply of 24 X SB5200 Falcon Concentrators for Phonesack Group's gold mine project ahead of schedule. In the span of 14 weeks, 4 separate shipments of 6 FALCON Concentrators each left Sepro's factory in Langley, British Columbia destined for the Khamkeut Saen Oudom (KSO) Mine, located near Lak Sao, Laos. This order compliments the Sepro equipment already operating on-site at the KSO Gold Mine, including several Falcon Concentrators and vibrating screens.

Based on its performance and strong service, a subsequent order of an additional 24 x FALCON SB5200 concentrators has been awarded to Sepro for KSO's project, considered the largest gravity gold project worldwide. This client made a thorough investigation of available competing equipment before making its considerable investment of dollars and confidence in Falcon technology.