Third Section

·The Northern Miner·

Pages 17 to 24

1967 Annual Review Number

Mill Of The Future No Bigger Than Your Office

Sound Waves To Break Ore, Near Perfect Recovery With Magnetics

By DAVID WESTON
Consulting Metallurgist

The Shape Of Things To Come

In this issue The Northern Miner has asked some of our contributors to take a deep look into the future — to tell us of the sort of things that they can imagine happening in years hence. These, then, are not necessarily things that are possible by today's engineering standards, but are the sort of things that might evolve on the basis of present knowledge.

On this page, Mr. David Weston, consulting metallurgist, who was responsible for the development of the Aerofall mill which introduced a revolutionary concept of grinding, looks into his crystal ball and relates what he surmises is just over the horizon. And, on Page 25, Mr. James A. Bates, of Watts, Griffis and McOuat, consulting engineers, hazards an opinion on how mining methods might develop. Interestingly enough, both engineers, see the laser beam, a Buck Rogerish high energy ray, as being a useful tool in carving out stopes or breaking down ore into its individual mineral constituents. And, how will labor cope with a society that needs only one man to do a job that now requires dozens? Mr. Murray Cotterill, of United Steelworkers, dons his X-ray glasses and peers into the next century. What he sees is unfolded on Page 23.

The metallurgical field as applied to the processing of raw materials has lagged far behind current technology. In the ensuing decade we will probably see a greater change in the use of modern technology than has been experienced in the past 40 years.

In the field of materials preparation, or what is commonly termed crushing and grinding, the major change from the arrasta or mule power comminution took place with the introduction of stamp mills just prior to the turn of the century. The tube mill, which until recently formed the basis of current technology, was introduced shortly after the turn of the century. The major developments during the 50-year interim period were the introduction of cone crushing and secondary developments in grinding with various degrees of improvement over the original introduction of the tube mill. Large diameter, short length mills feature more recent developments, making all but primary crushers obsolescent, together with the majority of tube mill installations.

In the field of concentration of minerals the family of xanthates were introduced shortly after the First World War and there have been only minor specialized developments in the flotation field in the ensuing 40-odd years. Gravity concentration still uses principles formulated in the last 75 years, and there have been no basic changes in magnetic separation since Edison (before the turn of the century) built his first magnetic separator primarily for use on Swedish magnetic iron ores.

In the field of leaching the chemistry in current use has been known for over 50 years and its use today is only the practical application of old technology. Probably the major advance in this field has been the application of bacterial leaching which still may be considered in its infancy.

DEVELOPMENTS BASED ON CURRENT TECHNOLOGY

The major metallurgical developments which will generally affect the mining and petroleum industries will probably fall into three broad categories:

1. In materials preparation the use of ultra-sonics and laser beams for the comminution of raw materials replacing in toto crushing and grinding circuits as they are known today. In addition, this same combination will probably revolutionize prospecting methods.

2. The broad use of high intensity magnetic fields heretofore considered impossible to attain on a sufficiently large commercial basis to justify their application to the fields of solids separation, gases from solids separation, and gas from gas separation.

3. Intermediate and complementary to the developments in the field of magnetism will be major developments in the field of flotation wherein mineral deposits will be comminuted to the point of liberation. And, regardless of the size distribution of the mineral constituents, flotation methods will be developed where practically all of the economic minerals will be able to be separated into acceptable constituents even in sizes down to a fraction of a micron.

OPERATIONAL PLANTS

In visualizing the mining-metallurgical complex of the future, whether from an open pit or underground, the mined ore will be fed into a series of two or three ultrasonic vessels. The total comminution of the material will take place in these units with the use of ultrasonic waves in combination with laser beams concentrating the energy of the sound waves in specific areas of the vessels. In underground mining this will eliminate the hoisting of ore, and will consist of drawing ore from an underground pocket, feeding it into an ultra-sonic-laser beam comminution circuit and pumping the pulp to the surface metallurgical plant.

As an example, the metallurgical plant for a 10,000-tons-per-day low grade copper-molybdenum deposit would occupy the space of a medium-sized office. In the first stage it would consist of two high intensity magnetic separators, probably 10 ft. in diameter by 1-ft. in length, which would concentrate and recover 98-99% of the copper minerals. The tailings from these two separators would pass to two separators of similar size which would concentrate and recover 98-99% of the molybdenum values in the ore. The full 10,000-tons-per-day operation would employ two operators per shift, i.e., one at the comminuting station and a second in the concentration plant. The total plant would be automatically controlled, with a panel board in the superintendent's office showing the tonnage being passed through the plant at any moment, the analyses of the two concentrates and the analyses of the tailings. Any change which the superintendent should desire in grade of concentrate versus recovery would be controlled automatically from the superintendent's office.

DAVID WESTON

SEPARATE ANY MINERAL USING MAGNETISM

Fundamentally, all minerals are susceptible to magnetization or repulsion from the magnetic field at a specific strength of magnetic field. Thus, theoretically, this form of concentration would produce 100% recovery of any specific mineral. There will be some minerals too close to others in magnetic susceptibility for effective separation. In a concentrate of such minerals new flotation developments will be used for their individual separation. The following is a table of the magnetic susceptibility of a number of well-known minerals common to the mining industry.

Substance	Relative Magnetic Attractability
Group I	
Iron (as a standard)	100.00
Magnetite	40.18
Franklinite	35.38
Ilmenite	24.70
Group II	
Pyrrhotite	6.69
Siderite	1.82
Hematite	1.32
Group III	
Zircon	1.01
Limonite	0.84
Corundum	0.83
Pyrolusite	0.71
Manganite	0.52
Calamine	0.51
Group IV	
Garnet	0.40
Quartz	0.37
Rutile	0.37
Cerussite	0.30
Group V	
Cerargyrite	0.28
Argentite	0.27
Orpiment	0.24
Pyrite	0.23
Sphalerite	0.23
Molybdenite	0.23
Dolomite	0.22
Bornite	0.22
Apatite	0.21
Willemite	0.21
Tetrahedrite	0.21
Group VI	
Talc	0.15
Arsenopyrite	0.15
Magnesite	0.15
Chalcopyrite	0.14
Gypsum	0.12
Fluorite	0.11
Zincite	0.10
Celestite	0.10
Cinnabar	0.10
Group VII	
Chalcocite	0.09
Cuprite	0.08
Smithsonite	0.07
Orthoclase	0.05
Stibnite	0.05
Cryolite	0.05
Enargite	0.05
Senarmontite	0.05
Galena	0.04
Niccolite	0.04
Calcite	0.03
Witherite	0.02

In the field of flotation, particularly in reference to the non-sulphides, the major problem in the past has been the effective separation and recovery of the slimed minerals. Fundamental breakthroughs have already been made in the ability to differentially float not only fines but also ultra-slimes as normal flotable particles. This breakthrough, in combination with the high intensity fields, will change the economics and sources of supply of a large

Continued on Page Twenty

Read Right 'Round The World

Today's issue, like every issue of The Northern Miner, will be read in no less than 63 countries of the world.

Back in the 1920's the total paid circulation of 'The Miner' was just over 300 copies weekly with distribution primarily in Canada.

The tremendous expansion and interest in the Canadian mining industry is reflected in the number of copies now going to foreign countries. Currently there are more copies being mailed to countries other than Canada and the United States than the total circulation was back in the 20's. Most copies mailed to distant points of the world are forwarded via air mail at the request of the subscriber for which he pays varying amounts according to distance and accessibility.

As witnessed by the various stamps seen here, any philatelist would have an exciting time just sorting the mail which comes into The Northern Miner offices every day.