Volume 21. Toronto, December 7, 1911

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The Canadian Engineer

An Engineering Weekly

MOLYBDENUM.

During the recent turning to commercial use of steel alloys molybdenum has played an important part and workable deposits located in Canada will doubtless give impetus to the steel industries of this Dominion.

Until recently, molybdenum was required only for the manufacture of chemical preparations, principally ammonium molybdate, which is much used in the determination of phosphoric acid. Molybdic acid is used as a blue pigment in the manufacture of porcelain, and for dyeing silks and woolens. In various compounds molybdenum is used for coloring leather and rubber. Ammonium molybdate is said to be used for fireproofing, also as a disinfectant for cloth used in railway passenger carriages. The importance of this element and its compounds to steel is caused by the similarity of the production to tungsten steel.

Molybdenum is more potent than tungsten, and only about half as much of the molybdenum is necessary as would be required were tungsten used.

Molybdenum steel is used for rifle barrels, propeller shafts, large guns, wire, and particularly for the manufacture of high speed tools. Molybdenum high speed steel contains from 8 to 10 per cent. molybdenum. When the other elements exist in the right proportion, a steel is obtained of great hardness, with the peculiar property of retaining its temper when heated to a high degree, differing in this respect from all carbon steels. Owing to this property it is possible to take extremely heavy cuts at high speed, the tool often being heated through this hard use to a dull red heat without impairing its usefulness.

Molybdenum was discovered by Carl William Scheele, a Swedish chemist, toward the end of the eighteenth century; to this chemist also belongs the honor of discovering and isolating chlorine, ammonia, manganese, bartya and oxygen. Molybdenum, although discovered by the above mentioned chemist, was not isolated from its compounds until several years later. It has an atomic weight of 95.3 (4 = 1) the symbol of Mo, it is a member of the tungsten uranium group, and has a specific gravity of 8.62. It occurs principally as sulphide (molybdenite) and as lead molybdenate (wulfenite); as an element it presents a white, extremely hard and brittle metallic appearance.

Molybdenite, MoS_2, is the commonest of the ores, and is the one most widely distributed in Canada. In color it resembles lead, and presents physical properties in many ways similar to graphite; the specific gravity of MoS_2 is 4.7 in contrast to graphite, which is 2 to 2.2. It has a hardness of less than 2, may be scratched by the finger nail, and when rubbed on white surfaces leaves a mark resembling that left by a pencil. It generally occurs in six-sided tabular crystals which may be split into thin sheets deficient in elastic properties. Occasionally molybdenum as the sulphide is accompanied by molybdite (MoO_3 [?])*; this usually is found as an earthy powder, quite soft and of a lemon yellow color.

Wulfenite has the formula $PbMoO_4$, and contains 39.3 per cent. MoO_3. This material may be briefly described as follows: color, yellow to brown; streak, almost white; specific gravity, nearly 7; hardness, less than 3 (easily scratched by the knife, but not by the finger nail); crystals, thin tablets, usually either four of eight sided. Wulfenite does not, so far as is known at present, occur in Canada in economic quantities. Wulfenite and molybdite are both alternation products of molybdenite, and may, therefore, be expected in the upper levels where oxidation is relatively prominent.

MoS_2, as a general rule, occurs in very coarse veins of granite, called pegmatite, which often intersect such rocks as gneiss, slate, and quartzite. They contain various minerals of economic value, principally muscovite and feldspar. Genetically these veins owe their origin to material derived from large masses of granite, which are usually to be found in the vicinity, and which probably occur at no great distance beneath the pegmatite mass. Molybdenite is occasionally present in these veins in varying quantities, and some of the important ore bodies of Canada are of this type, as, for example, those at Romaine in Quebec and Glengarry in Cape Breton.

Many quartz veins have originated in a method similar to pegmatite veins—the fissures have been filled by material derived from underlying, deeply-seated granite masses. Some quartz veins are almost free from feldspar, others contain so much that it is doubtful which should be designated.

The preparation of the crude ore for the market is one of the most difficult problems in ore dressing. Up to the present it is doubtful if a satisfactory solution has been arrived at. The mineral is very soft, and usually occurs in a very hard gangue, largely quartz and feldspar. In attempting to crush by stamps or rolls, much of the molybdenite is finely divided, so that a large loss results by sliming. On the other hand some of the larger flakes resist the action of the rolls, and may be separated by means of sieves. In density, molybdenite is heavy enough to separate readily by washing, were it not for its perfect cleavage giving rise to very thin scales and plates, which readily float away and are lost.

In general, there are three methods of molybdenite concentration which may be applied after cobbing and hand picking:—

The ore may be crushed and concentrated by washing. Mr. J. Walter Wells some years ago carried on experiments with this method of treatment in view. A brief report of the results of this work is given in the following extract:—

"Experiments were carried on by Mr. Wells for the purpose of finding suitable methods for concentrating the Canadian ores. On a sample containing 50 per cent. pyrrhotite, 10 per cent. pyrite, and 6.5 per cent. molybdenite in a gangue of calcite, biotite, quartz, and pyroxene, good results were obtained by crushing in a jaw crusher, hand picking of the large flakes of molybdenite, recrushing in rolls set to 0.2

*It has been recently shown to be somewhat complex, and to be a hydrated iron molybdate, containing 59.42 per cent. MoO_3.