

EXPERIMENTAL RESEARCHES IN THE REDUCTION
OF THE DIFFICULTLY-REDUCIBLE METALS.

BY A. J. ROGERS.

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This pamphlet of eighteen pages gives the result of experiments made by the author, upon the reduction of sodium and of aluminium from their salts, by electrolysis, at a high heat. The experiments are carefully made, giving proportions of raw materials, strength of current, time employed, and practical results as compared with the theoretical. The author gives first a *résumé* of some conclusions arrived at in a paper by him, read before the American Association for Advancement of Science, at Ann Arbor, in 1885, in which among other points established, he finds that from fused sodium chloride, 61 per cent. of the theoretical amount of sodium is reduced by electrolysis; this being the average result of six experiments. It thus seems that with suitable apparatus from 5 to 6 pounds of Na could be produced in 24 hours to one electrical horse-power, thus, if there were no practical difficulties in the construction of crucibles and other apparatus involved, nor in working continuously on a large scale with a raw material so cheap and pure as NaCl, the metal could be obtained at a small cost and could be applied to the reduction of other difficultly-reducible metals, including that very valuable metal Al.

He next turns his attention to the alloys of sodium with lead, and also with tin. He finds that "they can be heated to a higher temperature than pure Na or K, in acid (silicious) crucibles, without the Na or K attacking the crucible."

Description of the properties of the sodium-lead alloys are given: the proportions of the two metals varying from 1 part of sodium with 9 parts of lead, up to 1 part sodium with $1\frac{1}{2}$ parts lead. These richer alloys can be cut with a knife, like sodium, and act very rapidly when thrown upon

water. The same properties are peculiar to the sodium-tin alloys.

These alloys are formed by passing a current through melted NaCl in crucibles containing lead or tin serving as a cathode.

A series of nine experiments are reported, in most of which, however, cryolite was mixed with the salt. A small amount of aluminium was in all cases reduced, which was separate mostly from the lead- or tin-sodium alloy. But the principal yield of Al was obtained by heating the sodium alloy with cryolite afterwards in another crucible. It may be interesting to cite a part of one experiment.

“Experiment 8.—Passed 80 ampères with 24 volts through four crucibles in series, for six hours, using 1 part of cryolite to 3 parts of NaCl with 450 grains lead in each crucible. * * * Two hundred and fifty grains of quite pure Al was obtained, with a large amount of Na in the remelting with cryolite. There was then actually obtained, besides all losses, in round numbers, 1 pound of Al to the electrical horse-power per day of 24 hours.

“Probably 8 to 10 per cent. can be obtained from cryolite, where the theoretical yield is 12·85 per cent.

“The best results, and, in fact, the only quantitative results that have yet been published, so far as I am aware, for the separation of Al by electrolysis, are reported by Dr. John Hopkinson, of the Kleiner process, where 3 grains were produced to the electrical horse-power per hour, which would be about one-sixth of a pound in 24 hours.”

Mr. Rogers' results may be summed up as follows:

(1) The formation of a rich alloy of lead or tin with sodium, by electrolyzing common salt at a high heat, in presence of lead or tin.

(2) The reduction of aluminium from cryolite, or from the double chloride of aluminium and sodium, by simple heating with the above sodium alloy.

(3) A yield of aluminium, six times greater than has ever been obtained by electrolysis.

His paper is well worth the attention of all metallurgists.

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