In the next table we have the condensed results from a month's work with the above formula.

Cotton (scoured, upland)	416 pounds,	12 ounces
Nitric acid, sp. gr. 1.42–1.425 water white	4,957 "	
Sulphuric acid, sp. gr. 1.83–1.837	9,803 "	
Product	513 "	6 ounces

The high temperature nitrating formula taken as the example in this article will be found to lead to a correct judgment of the working of all such formulas. The consideration of the cold nitration method I shall make the subject of a separate paper at some later date.

IMPROVEMENTS IN THE MANUFACTURE OF SULPHURIC ACID.

By Peter S. Gilchrist.

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IN the JOURNAL for November, 1893, I gave a brief outline of the Hacker and Gilchrist pipe columns for saving chamber space, quoting results which had then been obtained in actual working. I wish to follow this with results of much greater interest.

As stated previously, the pipe columns were added to a plant having large chambers, the first three being each 160 feet long, and consequently not so effective as in combination with short chambers, the best work being seventeen cubic feet of chamber space per one pound of sulphur per twenty-four hours, and this with Glover and Gay-Lussac towers. The ratio of chambers have an important bearing on the amount of work done in a given space.

It has long been thought that short chambers were essential to good work, repeated experiments in Europe having demonstrated this, but there has been much tardiness in adopting them.

An observer of the chamber process notices that as the gases pass from one chamber to another a greater reaction sets in, consequently followed by an increased production of sulphuric acid. The reasons for this are obvious; the vapors strike against the surfaces of the chamber ends and the sides of the connection, causing the particles forming to interact more quickly. Again,

the gases being passed through a small aperture become better mixed, and the gases are also cooled by radiation from the lead surfaces, which is an important point in manufacturing. It has been proved in chambers of 100 feet and over, that after the gases have traversed fifty to fifty-five feet of the length the acid produced falls off considerably, so by cutting off the chamber at this point we get the maximum work from the chamber.

The important point in constructing a sulphuric acid plant is to endeavor to attain these conditions throughout the process as much as is possible, and if the mere passage of the gases from one chamber to another have such visible effects, how much more so, when these conditions are very greatly improved on, as is the case when using pipe columns.

The large, moist surfaces presented by the numerous pipes upon which the gases impinge, the thorough mixing which the gases receive by coming in contact with each successive layer of pipes, and lastly, the heat generated by the reaction, consequent upon the mixing, being carried off by the cold air passing through the pipes, are conducive to a very rapid formation of sulphuric acid.

The cyclone of last August having destroyed the acid chambers of the Darlington Phosphate Company, of Darlington, S. C., I was asked to superintend the rebuilding of the same.

The original plant consisted of three chambers, having a total capacity of 129,500 cubic feet, with a small coke tower in the rear, using Johnson's mechanical fines-furnaces, with no niter recovery, making at the outside eleven tons of 50° Beaumé acid per day.

The present plant consists of four small chambers, the first only fifteen feet long, its object being to catch the dust, the second sixty feet, the third fifty feet, and the fourth forty-three feet, having a total capacity of 100,800 cubic feet, with coke tower in the rear, using the same furnaces, and no niter recovery.

Between each chamber there is a pipe column averaging 3'.10" by 3'.5", and 13'.6" high, between the last chamber and the coke tower, a small pipe case 3'.0" by 1'.10", and 6'.0" long.

The average work for the last eighty-one days is as follows: Pyrites burned per day, 14,304 pounds, averaging 44.6 per cent.

sulphur, two-thirds being Virginian ore, and one-third Spanish, actually yielding forty-three per cent. sulphur. This is an equivalent of 6,153 pounds of sulphur, being 16.38 cubic feet of chamber space, per one pound of sulphur, per twenty-four hours, and in the cooler months was under fifteen cubic feet.

The average yield of acid for this period was fourteen tons of 50° Beaumé acid per day, or 4.552 pounds of 50° acid, per one pound of sulphur, per twenty-four hours.

As this means an increase over the total chamber area of seven-tenths of an inch, calculated as 50° acid, one can readily appreciate the amount of work done in the system.

The average temperatures of the chambers were as follows:

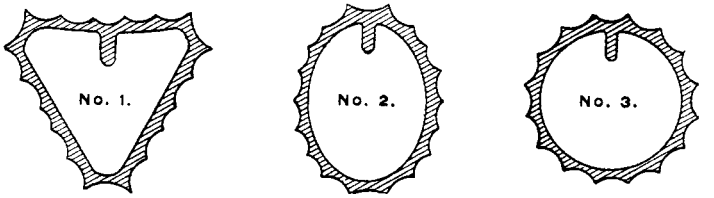
No. of chamber.	Front.	Back.
1	220° F.	222° F.
2	178° "	176 "
3	156° "	154 "
4	123° "	102° "

Atmospheric temperature, 73° F. Average oxygen in the escape gases, 6.6 per cent. Average acidity in the escape gases, 0.81 grains sulphuric anhydride per cubic foot.

The result of the application of the pipe columns over the original plant is as follows: Reduction in the size of the chambers, 21.84 per cent. Increase in the yield of sulphuric acid made, 28.18 per cent. equal to a total increase of 50.02 per cent.

Another plant is being completed in Savannah, Ga., having short chambers, pipe columns, Glover, and Gay-Lussac towers, which will, doubtless, confirm more fully the advantages of the pipe columns.

SECTIONS OF PIPES.



The construction of the pipe columns have been much improved, more especially in connection with the sections of the pipes used. The exteriors are made so as to enable the greatest amount of mixing to be got from a minimum surface of contact.