

SCOTCH METHOD OF CLEANING WATER MAINS.*

WATER mains lose capacity because of the formation of incrustations upon the inner surface and by sedimentary deposits. Both reduce the effective cross-section and increase the friction. Perhaps the formation of incrustations is the more important of the two. The reduction in capacity may become very great. A loss of 30 or 40 per cent. is not at all unusual. The modern remedy for such conditions is to clean out the mains. There are American methods of doing this, but it is the purpose of this article to give an account of a Scotch apparatus and the methods of using it.

The city of Ayr, in Scotland, derives its water supply chiefly from a lake in the neighborhood of the headwaters of the Doon River. This lake, Loch Finlas, is some twenty-odd miles to the south of Ayr. The supply is conveyed by a main 17 miles long to a service reservoir near Dalrymple which has a capacity of 7,000,000 gallons. For 2½ miles the main consists of 18-inch fire-clay pipe. The gradient of this stretch is 1 in 350. All the rest of the main consists of cast-iron, coated pipe. For 8 miles this main has a diameter of 16 inches and for 6½ miles of 14 inches.

Scraping Cast-iron Mains.—It was determined to scrape the cast-iron sections. The consideration impelling to this determination was the necessity of quickly increasing the water supply some half million gallons per day. It was hoped that this increase might be realized and the laying of a new main deferred for a time. The main was laid in 1887 and was calculated to have at that time a capacity of 2,592,000 gallons per day; but whether this calculation was ever verified is doubtful. However, in 1903 the measured capacity was found to be 2,037,000 gallons, and for 1911 the capacity was determined to be 1,865,000. It would seem that there had been a total loss of some 727,000 gallons daily. It was not unreasonable to anticipate, in view of these figures, that cleaning might restore the main to a condition equal to the necessities at the moment. This hope was fully realized. In fact, the capacity determined subsequently to cleaning was found to be within 46,000 gallons per day of the original calculated capacity.

Cleaning is supposed by some to promote incrustation afterwards. Granting this, the cost is not great, especially when proper provisions have been made in the pipe line, and cleaning may very well prove economical.

Cost of Scraping.—The cost, as reported by Mr. Jas. Macfazdean, assistant burgh engineer, Ayr, is divided between the 14-inch and the 16-inch lines and includes in both cases certain apparatus of a more or less permanent character. For the 14-inch pipe, 6.43 miles, the total expense was \$1,061, and for the 16-inch pipe, \$1,926, or a grand total of \$2,987. The apparatus cost for both sections amounted, however, to \$2,091. It will be seen from these figures that the actual cost really chargeable against the one cleaning is no great amount—perhaps \$1,200 (including depreciation, etc.), or \$82.76 per mile. In the United States, these figures would doubtless be increased somewhat because of the presumably higher cost of labor.

A sample of incrustation from the main was subjected to chemical analysis with the result that 70 per cent. was found to be peroxide of iron. A much smaller percentage

(2.57) was protoxide of iron. The carbonic acid percentage was 1.12. Water and organic matter accounted for 24.42 per cent. The remainder, totalling less than 2 per cent., was divided amongst several inorganic compounds. It will thus be seen that fully half of the incrustation came from the pipe. The water itself contains no iron. It is quite soft. Its analysis may be of practical interest, as affording a means of comparison:

	Grains per gal.
Total solids in solution	3.92
Chlorine	0.84
Sodium chloride equivalent	1.38
Ammonia (free)	0.0035
Ammonia (albuminoid)	0.0055
Oxygen necessary to oxidation of organic matter	0.42

The total hardness is estimated at 0.84 degrees.

It was decided to scrape the 14-inch section first. This decision seems now to be regarded as wrong, as that section was the lower part of the line. With the 14-inch main cleaned, the resistance to the on-coming water from the 16-inch pipe was so much less than with the smaller pipe uncleaned, that the pressure was reduced below proper working conditions in certain places, as described below.

Description of Process.—The whole line of cast-iron main was divided up into sections containing 1 or 2 miles each and hatch boxes were placed in position at the points of division. The bends were disregarded. This was permissible for the reason that the minimum radius of curvature was 18 feet. In placing hatch boxes, it is important, as Mr. Macfazdean points out, to take into account the disposal of large quantities of water in such wise as to effect no damage or inconvenience. These boxes may require to be left open for quite a number of hours, so that it is not permissible to locate them just anywhere. There will be an excavation, of course. It may seem advisable, in built-up sections, to wall these up and otherwise provide for permanence and accessibility. It is suggested that it is undesirable so to locate a hatch box as to have back drainage from any considerable length of pipe. Further, it is of importance to be able to control the water entering a given section at a point near the beginning of that section.

In the present case, the difficulties to be cared for were somewhat simplified because the main itself discharged into a reservoir containing nearly a three-days supply. The hatch boxes were placed, two at a time, every other day, under a requirement that water was to be shut off for no longer than 6 hours per day. There was only one considerable departure from the time requirement, and this was due to flood from the river.

The method of cleaning is briefly this: The hatch box is opened up and the scraping device put in place, when the lid is securely bolted on. Upon turning on the water, its forward impetus, operating against the pistons of the device, will serve to drive it ahead. Scrapers suitably disposed are carried along and perform their duty upon the incrustated surface of the pipe. The pressure was reckoned as a hydraulic head of 15 feet. There were two places where this head could not be relied upon, so that here hatch boxes were placed at either end of each of these short sections, so that the scraper could be hauled through by means of a line.

Prior to the cleaning of a section, the water is cut off from its length and a complete drainage effected. The hatch box covers are lifted off by means of a suitable

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