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LOW WATER IN BOILERS.

THE Manchester Steam Users' Association for the Prevention of Steam-Boiler Explosions and for the Attainment of Economy in the Application of Steam publishes (Manchester, 1889) the report of its chief engineer, Mr. Lavington E. Fletcher, on a series of experiments conducted by him to determine the much-debated question of the advisability of throwing cold water into a steam-boiler in which portions of the heating surfaces had become red-hot through shortness of water. The same investigator had, as early as 1867, performed similar experiments to those here described, on simple household boilers, and corroborated a deduction, coming of occasional accidental illustrations of the same phenomena, that the introduction of cold water into such boilers may destroy them by producing strain and seam-rips by the great and irregular contraction thus caused.[1] The special object of the recent experiments was to ascertain precisely what occurred when the furnace-crowns of fire-box boilers were left bare of water and overheated, and then flooded with feed-water.

A Lancashire boiler (7 feet diameter, 27 feet long), with furnaces 3 feet in diameter and grates 6 feet long, was used for the work. It was of $\frac{7}{16}$ inch iron, of ordinary construction, and set in the usual manner. Two feed-pipes were used,—the one, as commonly arranged, to discharge its contents behind the bridge; the other a special construction, throwing the water directly upon the crown of the furnace. Suitable barricades and "bomb proofs" protected the observers and others from danger in case of explosion.

Thus arranged, the boiler was subjected to repeated experiment; the water being blown out below the level of the furnace crown, sometimes to a greater, sometimes to a less extent; the feed water introduced, sometimes by the regular feed-pipe, sometimes by the showering arrangement; the pressures were sometimes high, sometimes low; the safety-valves sometimes open, sometimes closed. But in no case was the boiler injured by the introduction of the feed, and no explosion took place. In some instances the furnace-crowns came down; but this was always the effect of pressure, and not of the introduction of cold water, the latter invariably reducing the pressure promptly, except where the pressures were initially very low, or nearly atmospheric, in which case the introduction of the feed-water occasionally caused slight but momentary rise of pressure.

The conclusion of the experimenter is, that "these experiments put to rout the generally entertained opinion that showering cold water on red-hot furnace-crowns would cause the 'instantaneous disengagement of an immense volume of steam,' which would act 'like gunpowder,' overpowering the safety-valves however efficient, tearing the outer shell of the boiler to pieces, and hurling the fragments to a considerable distance."

The writer of the report goes on to say, "It would have been well if they had been tried some fifty years ago, in the days when high-pressure steam was young, when the cause of steam-boiler explosions was shrouded in mystery, and the easiest way out of the dilemma was to blame the stoker." But such experiments *have* been repeatedly tried in earlier years; and some of the most interesting and important, more than a half-century ago, by the Franklin Institute in this country, exhibited precisely the facts here again shown.[1] The later work of the United States Board of 1875 was but irregularly and unsatisfactorily published; but our information, such as it is, leads to nearly the same conclusions, with this important qualification: that while, as a rule, explosion does not result on introducing feed-water into a red-hot boiler, it nevertheless may, and sometimes does, take place. Mr. Fletcher concludes from these latest experiments that the right thing to do, on discovering low water in a boiler, is to put on the feed at once.

It would seem that this statement should be given the form, "The probabilities of fatal accident are slight in such cases, and the wiser plan is to at once put on the feed-water in full force, *then* proceed to dampen the fires. We would not draw them; that being certain to, at least momentarily, greatly increase the heat of the furnace."[2]

The report of the Franklin Institute was made to the secretary of the treasury in 1836. The conclusion reached was that the injection of water upon the heated surfaces of the experimental boiler produced a sudden and considerable rise of pressure.[3]

The work of the government board led to the conclusion by Dr. Thurston that "the overheating of the metal of a boiler in consequence of low water may or may not produce explosion, accordingly as the sheet is more or less weakened, or as the amount of steam made by the overflow of the dry heated area by water is greater or less."[4]

There would seem to be no question, in the light of our present knowledge, that low water, in some cases, may produce, or at least initiate, disastrous explosions; while there is as little doubt that it is only under conditions which are very rare, and very difficult of production, that such result may be expected to occur. The contributions of Mr. Fletcher to the literature and the facts of this important matter are as welcome as they are interesting and valuable.

[1] Mechanics' Magazine, May, 1867; London Engineer, March 15, 1867, p. 228.

[1] Journal Franklin Institute, vol. xvii. 1837.

[2] Thurston's Manual of the Steam-Boiler, p. 614, § 292.

[3] *Ibid.*, p. 635.

[4] *Ibid.*, p. 643. See also, especially, pp. 567, 568, arts. 277–279.