

SOME EXPERIMENTS ON LOCOMOTIVE COMBUSTION.

BY J. W. SHEPHERD.

Through the courtesy of the T. H. & I. Railroad officials, a study of the combustion in a locomotive while in operation was undertaken, the study being made from the analyses of the stack gases. The analyses were made with a modified Orsat apparatus.

The experiments were conducted on the large Schenectady passenger engines and on fast runs between Terre Haute and St. Louis, and Terre Haute and Indianapolis.

The apparatus for sampling the gases consisted of a half-inch gas pipe extending eight or ten inches into the center of the stack and bent uniformly following the outside of the stack to near its base, where another bend led it back to the cab on the fireman's side. Through this pipe, with the proper connections inside the cab, the gases were drawn into bottles by means of a steam jet. The bottles were fitted with ground-glass stoppers. The end of the gas pipe within the stack was fitted with a thimble, the lower end of which was solid steel and the sides perforated. This particular fitting was found to be essential to the successful operation of the apparatus.

Samples were taken in three different ways: (1) For periods of one to two minutes by displacement of water; (2) for continuous samples, from Terre Haute to terminals of road if desired, by displacement of water, and (3) for any period of time (brief as desired and whenever desired) by air displacement. In methods Nos. 1 and 2 the water displaced was acidulated with sulphuric acid. In method No. 3 the gas was passed five times before the bottle was disconnected from sampler.

Method No. 1 was not satisfactory, because the fireman did not fire normally during the sampling.

Method No. 2 showed that the value of a fire does not always vary directly as the increase of carbon dioxide and decrease of free oxygen in the stack gases. Samples Nos. 1 and 10 in the following table will serve as an illustration. No. 1 was taken continuously from Terre Haute to Effingham, Ill. (sixty-eight miles), and No. 10 from Effingham to East St. Louis (100 miles), both on same train, but different crews. No. 1 required less coal per car mile than No. 10. It is to be observed that No. 10 shows a percentage of carbon monoxide, which means that the rapid evolution

of hydrocarbons resulted in a fuel loss, and is largely attributable to the kind of firing. No. 9 was also a continuous sample, between Terre Haute and Indianapolis, and showed the least coal consumption per car mile of any. This must mean that more volatile matter escaped in No. 1 than No. 9. Carbon monoxide was not determined in sample No. 1, but No. 9 was analyzed for it.

Samples Nos. 2, 3 and 4 furnish an interesting study on the evolution of the volatile-combustible matter.

Samples Nos. 5, 6, 7 and 8 show more strikingly the rate of volatilization. While the percentage of carbon dioxide in samples Nos. 5, 6 and 7 remains the same, it is to be noticed that the percentage of free oxygen decreases, which means increased volatilization.

As a rule samples show less uniformity than shop tests on account of the jarring motion of the locomotive.

It is intended to make other tests in conjunction with temperature determinations with a view of determining percentage losses.

No.	CO ₂	CO	Free O	Kind of Firing.	Interval During Which Sample Was Taken From Time Fire Was Built.
1	9.1	.....	8.8	Medium	Continuous.
2	14.0	0.8	2.6	Heavy.....	20-30 seconds.
3	13.7	0.5	2.6	Heavy.....	35-45 seconds.
4	12.6	0.0	5.4	Heavy.....	50-60 seconds.
5	10.0	.....	8.9	One shovel.....	2-3 seconds.
6	10.0	.....	8.4	One shovel.....	3-4 seconds.
7	10.0	.....	5.5	One shovel.....	4-5 seconds.
8	9.4	.....	8.7	One shovel.....	5-6 seconds.
9	7.9	0.0	10.4	Light.....	Continuous.
10	11.0	0.7	5.24	Heavy.....	Continuous.

Medium fire, 2-3 scoops.

Light fire, 1-2 scoops.

Heavy fire, 4-5 scoops.