

i.e., compounds of carbon and hydrogen, which, while similar in chemical properties, show marked differences in boiling point and specific gravity. In the process of refining the crude oil by distillation, etc., a partial separation of its constituents is effected, and the more volatile portion, or naphtha, which distils over first and the less volatile parts—the burning oil and lubricating oil—are collected apart. The naphtha thus obtained is a highly inflammable liquid, which ignites at once at the ordinary temperature if a light is applied. When gently heated, it gives off vapour rapidly, and this vapour, when mixed with air in certain proportions, is dangerously explosive. Burning oil is less volatile and less easily inflammable than naphtha, and hence can be used with safety under conditions which render the use of naphtha impossible.

The test of the safety of a burning oil is its flash point. The flash point is the lowest temperature at which the oil gives off inflammable vapours, and is determined by an official method in the well-known Abel apparatus. The temperature at which the oil catches fire and continues to burn is a few degrees higher than the flash point. If naphtha is mixed with burning oil, the flash point of the mixture is found to be lower than that of the oil; and the greater the proportion of naphtha, the greater the depression of the flash point. Generally speaking, the more completely the volatile constituents (naphtha) are removed from a burning oil, the safer is the oil; because then its flash point, which is the point of incipient danger, is proportionately raised.

The legal standard of flash point in this country is 73 degrees Fahrenheit; in other words, any oil which flashes at or above that temperature may be sold and used as a burning oil with practically no restrictions. Now, in the opinion of many competent authorities, *that temperature is too low for safety*; and with that opinion I wholly concur.

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Another proposal has been made, which must commend itself to every one who has studied the question impartially, *viz.*, to raise the standard of flash point to at least 100 degrees Fahrenheit, or, in other words, *to prohibit the sale of dangerous low-flash oils*. If a safe oil is used—and, for practical purposes, an oil flashing not below 100 degrees may be considered reasonably safe, while oil flashing at 73 degrees should be regarded as an explosive—it is not of so much importance that the lamp should be faultless in construction; at any rate, the risk of accident with a faulty lamp is very much less. It has been objected to this proposal that the price of burning oil would be raised if the sale of low-flash oil were interfered with; but, on the other hand, it has been calculated by those who have every right to speak with authority that the increase in price would not amount to more than 1-2d., or, at the very outside, 1d. per gallon, and that is surely a moderate price to pay for comparative safety.

In a word, ought we to insist that none but good lamps shall be sold, in the hope that these will be used

in such a careful and intelligent manner that dangerous oil may be burned in them with little risk, or ought we to insist that none but comparatively safe oil, which may be used even in an inferior cheap lamp, shall be at the disposal of the public? I am certain of the answer which the members of the Insurance and Actuarial Society would give to this question.

Acetylene, which promises to come into extensive use as an illuminant, is, under certain circumstances, a dangerous substance; but the risks can be more or less completely set aside by taking proper precautions. Acetylene is now obtained with great ease. When a mixture of powdered lime and coke or charcoal is intensely heated in an electric furnace, a dark solid of metallic appearance is produced. This is the carbide of calcium (a compound of carbon and calcium), and when it is brought in contact with water a vigorous action takes place, and slaked lime and acetylene (a compound of carbon and hydrogen) are obtained. Acetylene is a colourless gas with a strong characteristic smell, which is fairly soluble in water, and is easily liquefied. It is very inflammable, ignites at a lower temperature than coal gas (about 480° C.), and develops great heat in burning. Under suitable conditions its flame is brilliantly luminous. A mixture of acetylene with air explodes with exceptional violence when ignited, and there is a much wider range in the composition of the explosive mixture than in the case of coal gas, hydrogen, or the other combustible gases in common use. All mixtures of acetylene with air, containing from about 3 per cent. to about 82 per cent. of acetylene, are explosive, while mixtures of coal gas with air, containing less than 7 per cent. or more than 30 per cent. of coal gas, are not explosive.

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The peculiarity of acetylene, which distinguishes it from other gases used as fuel or for illumination, is that it can explode, or, rather, can decompose into its elements with explosive violence, even if quite free from admixture with air. Liquefied acetylene, and acetylene gas when subjected to a pressure of two atmospheres or more, decompose explosively in this way when heated to redness, or when exposed to a shock, *e.g.*, the detonation of fulminating mercury, and in the case of the liquefied substance at least, the violence of the explosion is comparable with that of an explosion of gun-cotton.

It is obvious, then, that certain precautions must be taken if acetylene is to be used without danger. The following are the principal points which demand attention:—Calcium carbide is itself neither combustible nor explosive, but it yields acetylene very readily when acted on by water, or even by moist air. It must therefore be stored in such a way as to be completely protected from the action of moisture. Further, the carbide should be of the best quality; for, if impure, it may, when exposed to the action of water, yield, along with acetylene, such substances as phosphoretted hydrogen and sulphuretted hydrogen, the presence of which is very objectionable. The former