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REPORT OF A VISIT TO THE SCENE OF A FIRE AT METAL COLOURS (SLOUGH) LTD.

by

D. J. Rasbash and E. H. Coleman

Summary

An explosion and fire occurred at Messrs. Metal Colours (Slough) Ltd. Dr. D. J. Rasbash and Mr. E. H. Coleman visited the works at the request of the Bucks Fire Brigade Fire Prevention Officer.

It is considered that an overheated nitrate bath exploded and scattered hot fragments which started the fire. Overheating was probably due to faulty controlling mechanism and the absence of an over-riding cut out.

Attention is drawn to the failure to observe published recommendations and precautions.

File No. 1010/1/1981

June, 1955.

Fire Research Station,
Boreham Wood,
Herts.

REPORT OF A VISIT TO THE SCENE OF A FIRE AT METAL COLOURS (SLOUGH) LTD.

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Introduction

At the request of Mr. Tucker, Bucks Fire Brigade Fire Prevention Officer, Dr. D. J. Rasbash and Mr. E. H. Coleman visited the scene of a fire which occurred at 2.30 a.m. at Messrs. Metal Colours (Slough) Ltd. on 8th June 1955. The visit was made at 11 a.m. on the same day after the fire was extinguished and before salvage work had been started.

Messrs. Metal Colours (Slough) Ltd. occupied a single storey, single bay, factory on the Slough Trading Estate. A plan of the site is shown in Fig. 1. The building was of light construction, with $4\frac{1}{2}$ in. brickwalls, light angle iron roof trusses, and asbestos cement roof.

The company carried on several activities including:-

- (1) heat treatment of small metal parts for other firms,
- (2) cadmium and copper plating,
- (3) manufacture of lead nitrate for subsequent conversion to chrome yellow and Brunswick green paint pigments. Some lead nitrate was sold for manufacture of lead azide and styphnate.

The factory contained stocks of sodium cyanide, hydrochloric, nitric and sulphuric acids, lead carbonate, and sodium bicarbonate in addition to barrels of finished lead nitrate.

Heat treatment was carried out in three nitrate baths supplied by Messrs. Imperial Chemical Industries Ltd. All were gas heated and fitted with roller chart - pen temperature recorders which also controlled the temperature of the bath, which was maintained between 520°C and 530°C . The recorders were fitted with indicators set to the required temperature, and when the recording pen touched them, relays and mercury switches operated to reduce the gas supply. No over-riding cut outs were fitted.

Description of the occurrence

The evening shift of 7th June loaded bath No. 1 with small aluminium castings (alloy DTD272) with threaded steel inserts. The castings were in steel baskets. The works was shut down at 10 p.m. and the bath was left running so that the treatment would be finished by the morning.

An estate security patrol visited the works at 2 a.m. 8th June, 1955 and did not report anything wrong. At about 2.30 a.m. two workmen in the factory next door noticed fumes, and, looking through the office windows saw a red glow. While they were on their way to telephone the fire brigade there was a violent explosion followed by two minor explosions. The explosion was heard at the Slough Fire Station 2 miles distant.

The explosion blew out the walls and removed the asbestos cement roof. Debris was scattered over a wide area. The main force of the blast was in the direction shown by the arrow on the plan (Fig. 1). Asbestos roofing and glass windows at Messrs. Mars Ltd. were broken and a portion of the metal end of the bath was found about $\frac{1}{2}$ mile away. The works next door to Messrs. Metal Colours (Slough) Ltd. was gutted by fire.

Inside the works, No. 1 nitrate bath had disappeared leaving a crater about 8 ft. x 6 ft. Bath No. 2 had been torn apart. The outer casing of $\frac{1}{4}$ in. steel was bent inwards, and the inner pot of $\frac{1}{2}$ in. mild steel torn open. Bath No. 3 was not damaged.

Fragments had punctured the oil pipes on the transformer (No. 4 Fig.1). The rear of the lorry was burnt away, and the heat had been sufficiently intense to soften the rear road springs. The previous evening the lorry had been loaded with wooden barrels containing lead nitrate, and the petrol tank had been filled ready for starting in the morning. Some of the barrels had rolled out and were charred. In spite of the intensity of the fire at the rear of the lorry the petrol tank was not affected and contained its full amount of petrol.

About 8 ft. from bath No. 1 there was a reinforced concrete platform 6 in. thick, supported on 12 in. square reinforced concrete pillars 7 ft. high. The top of the platform was enclosed with wire netting and was used as a store for sodium cyanide. At the time it contained about 2 tons in 1 cwt metal drums. The store also contained rubber gloves and aprons and clean towels for the work people. The explosion removed the corner pillar, and a portion of the platform about 8 ft. square had collapsed with the wire netting, and drums of cyanide were scattered around.

The operation of sodium nitrate heat treatment baths

Molten sodium nitrate with 10 per cent sodium nitrite is used as a heat transfer medium for heat treatment of metals.

Chemical reaction between the molten nitrate and aluminium is very slight at about 500°C, so also is the reaction between the molten nitrate and the iron of the bath. Excessive heating results in the decomposition of the nitrate.

The presence of magnesium in alloys increases the possibility of explosion, and alloys containing more than a small percentage of magnesium should not be heat treated in nitrate baths. Alloy DTD272 contains only 0.4 to 0.6 per cent magnesium.

During the operation, sludge containing finely divided metals and oxides is deposited at the bottom of the bath. The principal constituent is iron oxide and contact with aluminium may result in the well known "Thermit" reaction if over heating occurs.

Sludge should be removed regularly by dredging, and periodically the bath should be emptied and cleaned.

In view of these hazards it is absolutely essential that over-heating should be avoided and therefore the temperature control of the bath should be completely effective, this means that over-riding controls should be installed. Furthermore, the baths should be under close supervision by properly instructed and competent persons at all times when they are being supplied with heat.

Signs of over-heating are bubbling, and in extreme cases a faint red glow is observable. Over-heating is usually a slow process since the heating devices, electric or gas, are so adjusted that the rate of heating is slow, even if the control fails to operate, and early signs of over-heating are manifest in time for precautionary measures to be operated.

Precautions to be observed for operating these baths are given in several official publications viz.

- (1) Factory Form 848, "Memorandum on precautions in the use of nitrate salt baths."
- (2) Factory Form 849. A cautionary placard setting out the principal safety precautions.
- (3) National Board of Fire Underwriters Research Report No. 2. "Potential hazards in molten salt baths for heat treatment of metals".
- (4) Fire Offices' Committee "Recommendations for the installation and maintenance of nitrate baths".

The baths seen at the factory carried brass plates containing operating instructions and precautions.

Discussions and observations

The works chemist and technical manager, Mr. Martin, stated that the recorders and controllers were inspected monthly by the makers and a satisfactory certificate had been issued by them recently.

During the visit contact was made with Mr. Rigby of Imperial Chemical Industries Ltd. who is the service engineer for nitrate baths. He said that he had been told that on occasions faults had developed in the recorder which may have prevented it from operating satisfactorily. It is possible that such a fault had occurred during the night of 7th/8th June, and in the absence of an over-riding cut out, over-heating became serious. The reaction between over-heated nitrate and sludge resulted in the explosion. Had the bath not been left unattended over-heating should have been noticed at a stage early enough to have permitted shutting down.

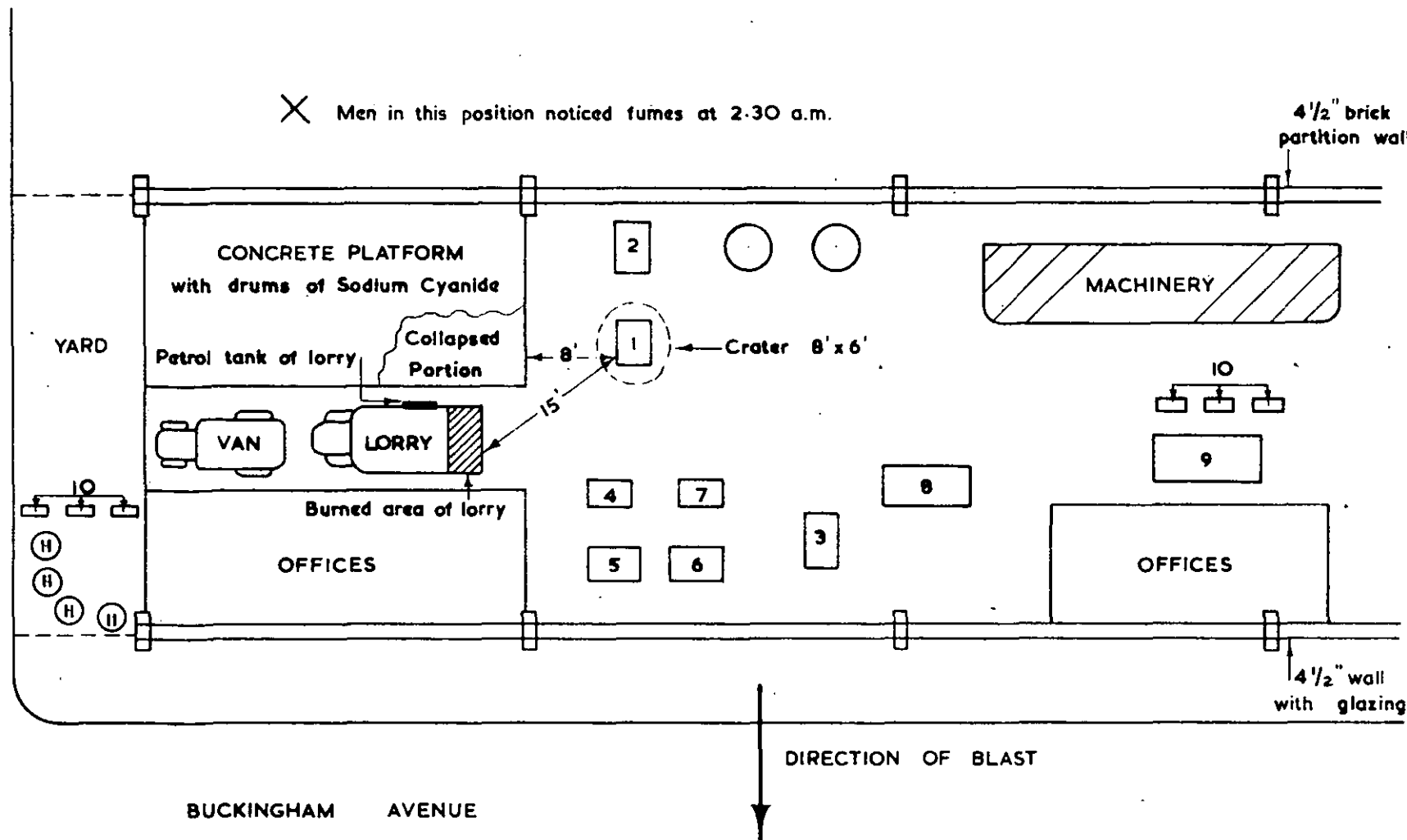
Mr. Rigby also said that his company was concerned about baths being left unattended and that he had been informing all the users in his area that this practice was unsafe. Imperial Chemical Industries are also pressing for the installation of over-riding cut outs.

Conclusions and comments

It is considered that the explosion was due to the over-heating of No. 1 nitrate bath. The hot fragments scattered by the explosion initiated the fires which were intensified by oil leaking from the fractured transformer.

The occurrence emphasizes the importance of avoiding over-heating, and of compliance with the instructions and precautions required for safety, as for instance in Factory Form 848, especially that concerning leaving baths unattended. Had the night patrol been more fully instructed he should have noticed that the bath was over-heated at 2 a.m. when he made his visit.

There was also a lack of regard for the hazard of storing, in one compartment, a number of compounds, any one of which might be hazardous by itself, but which in combination would create a major hazard. Thus sodium cyanide was stored only a few feet from molten sodium nitrate and only a little further away from an open top tank containing 30 per cent hydrochloric acid, it was also close to a motor vehicle, loaded with lead nitrate - a powerful oxidising agent - and this was close to the open gas flames of bath No. 1. It is surprising in this connection that despite the fierce fire at the rear of the lorry, the petrol in the tank, only 3 ft. away was not affected.



1. Nitrate baths
2. " "
3. " "
4. Low tension transformer for plating baths
5. Plating bath
6. " "
7. Pickling tank with 30% hydrochloric acid
8. Trichlorethylene degreasing bath
9. Oil fired boiler
10. 40 gal drums of 95% nitric acid
11. Elevated tanks containing sulphuric acid

NOT TO SCALE

All Dimensions Approximate

FACTORY OF MESSERS MARS LTD.

FIG. 1. SKETCH PLAN OF WORKS OF MESSERS METAL COLOURS (SLOUGH) LTD.