HSE

Health and Safety Executive

Fire and Explosion Hazards during Pneumatic Discharge of Road Tankers Handling Explosible Dusts

◆OC 283/14

Target Audience:

Agricultural, Factory and Quarries Inspectors
FCG Specialist Inspectors (Fire and Exp)

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SUMMARY

Introduction

1 The attached Information Document describes the fire and explosion hazards during pneumatic discharge of road tankers handling explosible dusts. The Information Document (ID) may be copied and given to interested persons outside HSE.

Background

2 In recent years Technology Division has obtained details of a number of incidents involving the ignition of explosible powders while bulk road tankers were being discharged. The majority of incidents have involved food materials, which are the most widely handled explosible powders, but the problems and solutions are more generally applicable.

3 The largest manufacturer of pneumatic discharge equipment used on bulk powder vehicles in the UK, who has 60-70% of the market, has reported receiving information on about one incident/year, from an estimated 2500 tankers. Most of the incidents did not cause any injuries, and may not have been reportable to HSE under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985.

Action by users

4➔ ➔[1] have taken steps to replace silencers lined with polyurethane foam (see ID para 7).

5➔ ➔[1] insist that hose used for transporting pulverised coal is fitted with an internal wire bonded to the ends (see ID para 10).

Further research

6 The RLSD Explosion & Flame Laboratory at Buxton is undertaking a research programme, sponsored under the auspices of the British Materials Handling Board, on the effects of dust explosions in plant vessels connected by ducts of various length and cross-section, which may lead to further guidance on the safeguarding of pneumatic transfer systems.

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ASI headings

Dust(s): explosion: fire: powder: pneumatic discharge: tankers.

[1] Exemption 15 – Statutory and other restrictions (Health and Safety at Work etc Act 1974 Section 28)

Health and Safety Executive **Information Document**
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FIRE AND EXPLOSION HAZARDS DURING PNEUMATIC DISCHARGE OF ROAD TANKERS HANDLING EXPLOSIBLE DUSTS

1 This document contains internal guidance which has been made available to the public. The information may not be directly applicable in all circumstances and any queries should be directed to the appropriate enforcing authority.

2 There have been several incidents involving the ignition of explosible powders whilst bulk road tankers were being discharged. This document describes the problem and recommends precautions.

TRANSFER SYSTEM

3 Most pneumatic transfer systems have certain common characteristics. During transfer, the powder concentration within the transfer pipe is likely to be outside the explosible range; but at the point where the powder discharges into a silo or hopper, and also in the pipe at the end of a delivery, a cloud of dust within the explosible range will inevitably occur. If the powder flow is uneven, explosible concentrations of dust may also be formed within the system at other stages during the transfer. It is therefore particularly important to avoid all sources of ignition and to prevent any possibility of burning particles spreading from the delivery vehicle to the silo.

4 The normal discharge system for bulk powder tankers involves supplying compressed air, both to the space above the powder in the tanker, and also into the powder outlet line through a venturi which fluidises the powder. Towards the end of a discharge operation the air supply to the bulk tank may be isolated, and if the compressor is subsequently turned off before the pressure in the tank is released, the residual pressure may force some powder back up the air line.

5 Non-return valves are commonly installed in such systems, but they cannot be relied upon, especially when handling sticky products such as sugar or starch. Where powder does travel up the air line against the normal direction of air flow, if it reaches the air compressor frictional heating may then initiate a fire.

6 Oil mist, which is a known cause of compressor fires at fixed installations, does not seem to be the cause of the problem on road tankers, where the compressors run for comparatively short periods at low pressures.

7 A number of the incidents were made more severe when polyurethane foam, which had been used in the airline silencer, became involved. The foam, sandwiched between an outer metal case and a perforated inner case was of a flame retardant type, but did burn at temperatures over 180^{o}C.

ELECTRICAL

8 Static electricity is a potential source of ignition that will be generated during the pneumatic transfer of material, but unless the powder has a very high resistivity (10^9ohm.m) or flammable vapours are also present, a static discharge from within the bulk powder itself is unlikely to build up sufficient energy to cause ignition in an all metal plant.

9 Problems with static are much more likely to arise where an unearthed metal item is in contact with the powder. Sufficient charge may then collect on the metal to create an incendive spark. Therefore all metal parts of the fixed installation should be earthed and, in addition, the road tanker should be earthed to the installation before transfer begins.

10 Some discharge hose is of all metal construction and should adequately bond the tanker to the plant. Other hose made of rubber or similar material has an outer wire reinforcement. Provided this wire is bonded to metal end couplings it should provide adequate earthing for the vehicle. Hose has been seen with internal wire reinforcement not bonded to the couplings, this may create a hazard.

11 Abrasive materials like coal will wear away the inside of any hose, and if metal reinforcement embedded in polymer is then exposed the problem of an unearthed conductor may arise.

12 Reinforced hose with plastic end couplings is sometimes used which could create similar problems unless provision has been made for the reinforcing wires to be bonded to the rest of the transfer system.

RECOMMENDED PRECAUTIONS

13 The following recommendations may be applied to the whole range of industry handling flammable powders and using pneumatic transfer from road (and possibly rail) tankers.

(1) Before transfer begins, the vehicle should be electrically bonded to the receiving installation. This is preferably achieved by using transfer hose of all metal construction or which is otherwise designed to have a low resistance between the ends, eg by bonding the reinforcing wire to metal end couplings. Separate earthing straps can achieve the same purpose but they can easily be broken or forgotten.

(2) The transfer system should be electrically bonded throughout its length. In particular, earthing straps should be provided across points of discontinuity such as a sight glass or a section of plastic pipe. The use of long lengths of plastic pipework should be avoided. Provided that all metal parts of the system have a resistance to earth of less than 10^6 ohms, it should provide adequate conductivity for most food products. Earthing straps should not be necessary for normal bolted flange joints.

(3) Any hose or pipe made of insulating material incorporating metal reinforcement on the inside surface should have the reinforcement electrically bonded to the end couplings. Similarly, metal reinforcement embedded in insulating material

should be bonded to the couplings if the hose is used to transfer abrasive powders.

(4) Wherever possible metal pipe couplings should be used. Plastic couplings should only be used where satisfactory alternative means have been provided to ensure the continuity of electrical bonding.

(5) Any non-return valve fitted on the vehicle downstream of the air compressor should be inspected regularly for effective operation. Where none is fitted the tanker operator should consult with the manufacturer of the discharge system and where reasonably practicable fit such a valve.

(6) To avoid the back flow of powder the operating instructions for tanker discharge should clearly indicate that before the compressor is turned off, all vents in the downstream system should be opened, for long enough to depressurise the tank and discharge equipment. Alternatively, positive isolation of the air supply line downstream of the compressor should be specified. In this case protection of the compressor to prevent overheating while working against a closed pipe is likely to be needed.

(7) Vehicle operators should note that combustible foam or wadding should not be used inside silencers fitted on the outlets of vehicle air compressors.