Automatic Filling Nozzle for Explosive Materials

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Rayman Ltd have developed an ATEX approved filling nozzle for Sokolovska uhelna a.s. plant in Vresova, Czech Republic, where it is used for loading coal powder into bulk tanks for road transportation.

Filling nozzles are used for dust reduction during loading of bulk materials into road and railway bulk material tanks. They are height adjustable devices in which the dusty air flow is separated from the material flow. Such nozzles are either connected to an external exhaust system or are equipped with an integrated filter and exhaust flow fan. When handling dusty materials, that – together with air – can create an explosive mixture, it is necessary to use a filling nozzle that has been approved by an authorized entity according to the European directive 94/9/EC ATEX100 and EN 61241 standard.

Rayman Ltd. recently developed such a special filling nozzle, the SPHFn 300, for loading dry coal powder into road tanks for the Vresova plant of Sokolovska uhelna a.s., Czech Republic. This article provides some information about the requirements that had to be met, how the system is designed and where the new system can be used.

Specification of Explosive Environments According to Atex

The ATEX comprises two directives of the European Union: 94/9/EC and 1999/92/ES. According to the directives, the environment can be divided into different zones depending on the probability of the formation of an explosive atmosphere and how long this explosive atmosphere prevails:

Zone 20: Areas, where an explosive atmosphere with turbulent clouds of flammable dust occurs permanently or often and for long periods (more than 1000 h per year).

Zone 21: Areas with a probability of occasional presence of an explosive environment with turbulent clouds of flammable dust (10 to 1000 hours per year).

Zone 22: Areas where the formation of an explosive environment turbulent is improbable or where it occurs only in exceptional cases and for a short time (0.1 to 10 h per year).

Working Conditions for the new Filling Nozzle

The new filling nozzle was initially designed for loading dry powder lignite coal from the storage silo into the road containers. At the customers plant, coal dust is stored in a silo under nitrogen atmosphere. The bottom of the silo is equipped with aeration nozzles supplied by pressurised nitrogen. The material is delivered from the storage silo to the filling nozzle via a rotary feeder with the minimal capacity of 40 t/h and a sliding pipe.

The design of the new filling nozzle is based on a previously existing system that consists of a filling and a filter section, with the filter inserts integrated between the external and internal filling

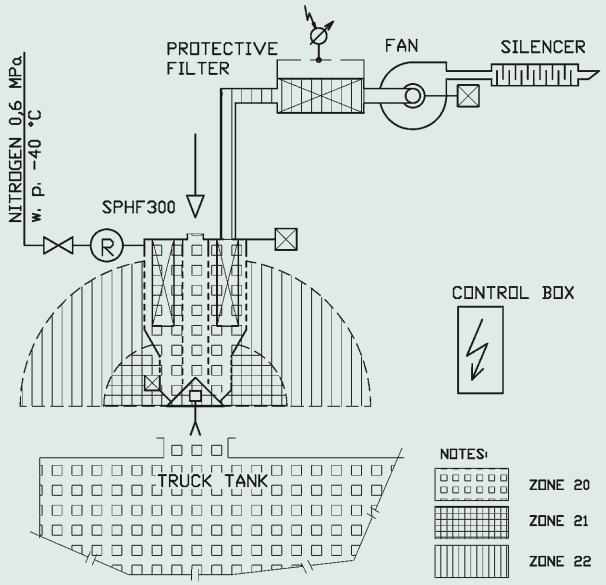

Fig. 1: Location of ATEX zones at the loading facility.

nozzle sleeve. Regeneration of the filter inserts is done by pressurized air from a JET-system. These filling nozzles are generally equipped with a suction fan mounted directly to the socket on its top head. The initial system features a "one rope" design, which means that the bottom part is carried by a single rope in the centre axis of the nozzle.

In the first phase of the development project, the customer, together with the general designer and nozzle supplier, identified the different ATEX Zones of the loading facility, which are:

- inside the storage silo - zone 22
- inside the filling nozzle - zone 20
- inside the bulk material container - zone 20
- distance up to 0,5 m from road tank filling socket - zone 21
- distance up to 1 m from road tank filling socket - zone 22
- distance more than 1 m from road tank filling socket - zone without danger of flammable dust explosion
- "clear" filter side - zone 22

Filling Nozzle Design

The identification of the different ATEX Zones was fully accounted for during the filling nozzle design, as specified in the order. Fig. 1 shows the location of the different zones. The guarantee protection of the power supply cables of level gauge inside the nozzle against abrasion by falling material, it was decided that the nozzle should be designed as a three rope system with fixed bell and movable sleeve of the filling head. However, the basic filling nozzle design remained unchanged and, thus, the new system also consists of a filling and a filter section.

Fig. 2 shows a cross section of the new SPHFn 300 filling nozzle for explosive materials handling. The outlet part is coated with antistatic rubber. All sleeves, with sewed-in steel rings, are made of the antistatic textile material VINITOL® for a maximum temperature of +55 °C. The outlet sleeves are also provided with pull-down springs.

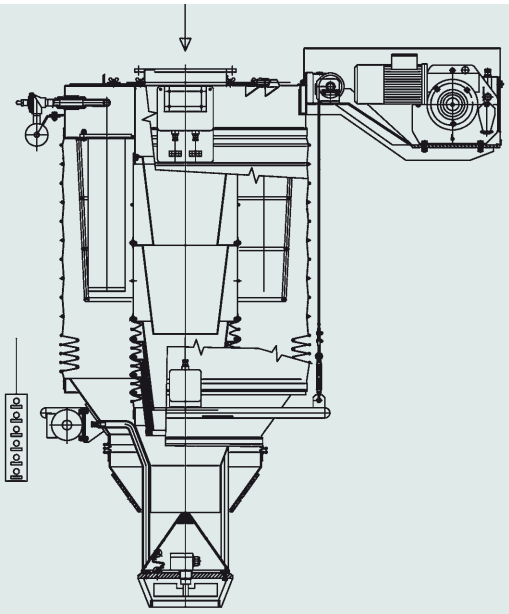

Fig.: 2: Cross section of Rayman's loading nozzle for explosive materials, type SPHFn 300.

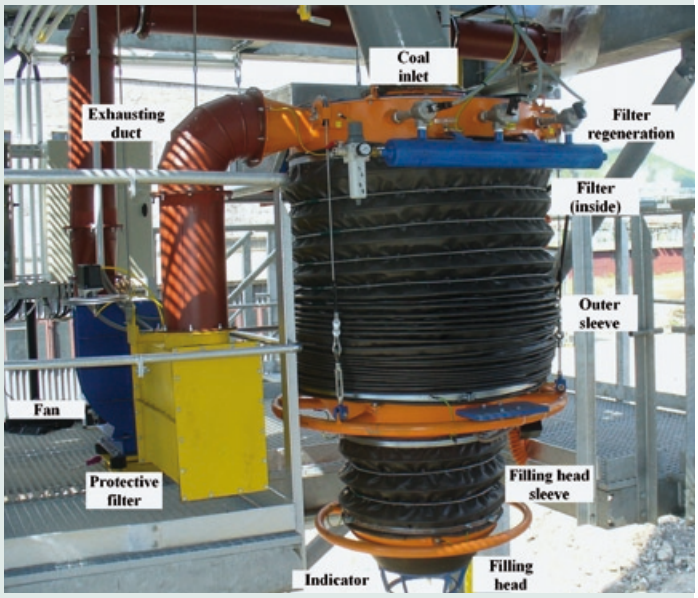

Fig.: 3: The loading nozzle installed at the Sokolovska uhelna a.s. plant, Vresova, Czech Republic.

The filtration section comprises a filter cartridge with replaceable supporting basket and Venturi pipe (antistatic finish), a regenerating gas distributor, the regeneration system (electromagnetic valves with regeneration pipes), and the outlet chamber with a connection to the suction fan. The fan supplied with the nozzle is mounted on the steel structure of the storage silo near the nozzle in an area without explosion hazard.

To be able to use a standard fan type, the suction pipe between the fan and the nozzle is provided with a protective filter. Its purpose is to capture coal dust that could otherwise penetrate into the fan in case of faulty or damaged filter cartridges in the filling nozzle. For security reasons, the filter is also equipped with a manostat. In case of filter clogging, a signal from the manostat triggers a nozzle filter failure signal and the loading process is stopped. This solution allows for the use of a standard fan in spite of zone 22 specified for the suction socket of the filling nozzle. In order to comply with safety regulations, the filling nozzle was designed with additional earthing connections and individual parts of the nozzle were interconnected by copper conductors. All non-metallic parts were designed in antistatic finish (filtrating cartridges, sleeves, rubber coating of contact cone), and to eliminate any possible sources of explosion ignition, certain parts of the filling nozzle have been manufactured from non-sparking steel.

Electrical Equipment

The filling nozzle has a cable interface into the terminal bar at its bottom head (level gauge, vibrator). The terminal bar has been designed for environment with hazard of flammable dust explosion (zone 21). Outlets of all electrical appliances are terminated in a common terminal bar (protection IP55) placed on the top head of the filling nozzle. Separate cables connect the level gauge and proximity switches. Overhead control designed for zone 21 is used. The distribution board of the filling nozzle contains a Siemens PLC unit type SIMATIC LOGO 24RCL for working cycle control. There are two spare outlet contacts left for subsequent equipment control. The terminal bar on the top head of the filling nozzle and the distribution board are specified for environments without flammable dust explosion hazard.

Conclusion

So far, four filling nozzles of type SPHFn 300 have be supplied to Sokolovska uhelna a.s. (Fig. 3). The nozzles were certified by the authorized test institute FTZU Ostrava – Radvanice and received the compliance certificate No. FTZU 08 ATEX 0035. Successful certification and a year of operation under harsh conditions proved that the filling nozzles of SPHFn type are capable of heavy duty operation wherever loading of dry, bulk, powder or fine granulated explosive materials occurs. The filling nozzle can also be used for loading other explosive materials, e.g. coke dust, flours, sugar, artificial fertilizers, plastic powders, etc.

Classification of explosive zones according to Fig. 1 has to be respected. If the explosive zone 22 spreads more than 1 meter from the container socket, it is necessary to use an electric installation with proper protection, certificated pulse filter valve, and a winch approved for the operation in the appropriate zone. Alternatively, the winch can be placed outside the explosive zone and outside the filling nozzle, e.g. attached to an adjacent building structure. ■

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