

December 2014

Prevent explosions of metal dusts: analysis of a real case

An explosion is a very complex physical-chemical process, which responds to dynamics not always easy to completely predict. We all know the pure theory: it's necessary the presence of fuel, combustion and ignition energy to trigger an explosion. It's not always easy to foresee, however, how these components are combined and how they are simultaneously present in the course of a machining process. Therefore, a necessary condition to lower the risk level is a more comprehensive prevention action that takes into account the most critical possible factors.

This article will analyze a technical incident really happened (source: documentation ASL 14 VCO of Piemonte Region) and will draw conclusions about what can be done to prevent a similar incident.

Analysis of a real case

The case reports of an explosion occurred in a medium-sized company, in which are performed sanding and other surface treatments of aluminum coffee makers. The explosion affected the whole suppression system of aluminum dusts generated inside the dusts fighter.

The cause of the explosion, in this case, can be traced back to a sudden increase of pressure, within the system of dust, generated during the production process. The breaking of the abrasive belt, which occurred within the belt-sanding machine case, caused the mixing of the accumulated aluminum dusts and the production of sparks that triggered the reaction.

The first small explosion, therefore, was generated directly inside the machine and this has caused the production of sparks and incandescent fragments that have been sucked by the dusts fighter causing the ignition of the aluminum dust in the lower part of the cyclone.

By itself, this explosion would not be such as to create damage and a potential danger for operators.

In the document of the risk assessment, in fact, it's estimated that, on the basis of the values of flow rate of aspirated air, the amount of dust capable of sustaining combustion inside the machines fittings was very low and the concentration was far below the lower explosive limit.

But the secondary explosion was much more violent than the one occurred in the cyclone, which, in addition to completely destroy the bag filter projecting fragments to over 50 meters, has caused structural damages, fortunately not to the people.

Was not taken into account, in fact, that the flame front would be channeled both in the exhaust pipe of the cyclone, toward the bag filter, and in the two intake manifolds, causing the combustion of the powders present in the belt-sanding machine bins. In addition, the channeling towards the filter, favored by the suction, caused the multiple trigger of very fine dusts present in numerous spaces and gaps existing between the suction hose.

It was, therefore, the secondary explosion, caused by the accumulation of dust in the system set in motion by the primary explosion, to create the real disaster. And this possibility was not foreseen by anyone.

Prevention

As we said at the beginning of this article, in this kind of activity, the likelihood of an explosion depends on the simultaneous presence of these three conditions:

- presence of combustible dust aero-dispersed;
- concentration of the suspension, including the dust, within the explosive range;
- ignition source with sufficient energy to trigger the reaction.

Given that the work activities, as almost always happens, not allow operating in inert atmospheres, some prevention measures should always be taken to minimize the possibility that the two remaining conditions occur:

- cleaning the workplace with non-sparking equipment and in accordance with procedures;
- avoid cleaning with compressed air in order to not raise clouds that may come into contact with ignition sources;
- equip all machines of at least one capture device of dust;
- adopt extraction systems designed and managed so that to have adequate suction and capture speed, to enable the capture of all the dust produced;
- in the choice of the machine location, follow the principle of minimization of pipes changes in direction and the section of the suction system;
- the inner walls of the suction conduits must be smooth and with overlapping joints mounted upwind to avoid accumulations;
- avoid the presence of blind ducts and duct sections temporarily unused, always to avoid accumulations;
- cleaning of the suction conduits and of the plant in general;
- the conduits junctions should be oriented such that, in the event of violent opening, the duct sections are projected away from personnel;
- cleaning of the exhaust stack of purified air;
- preventing the introduction of the material collected during clean inside the intake manifold;
- prevent foreign objects from entering the suction openings;
- prevent foreign matter from coming into contact with the moving abrasive belts.

Once all these measures have been taken in order to avoid "mechanical" causes of factors which may trigger the explosion, should be adopted prevention principles, especially for the electrical system feeding machinery and lighting:

- always install plant and equipment specific for hazardous areas, certified for the use with the materials used in the production cycle;
- prevent the accumulation of static electricity through the grounding of all machines and equipment;
- provide for block and signaling procedures for the machines disconnection;
- all heat and ignition sources in areas with possible presence of an explosive atmosphere must be eliminated. For example, welding and assembly operations that require the use of welding equipment and flame or incandescent tools must be carried out in places specially equipped;
- the intake ducts must be made of conductive material and grounded;
- also in the case of dry separators, the filter cloths of the separator must be made of conductive material;
- the separator should be made of anti-static material.

TECHNICAL NEWS



To be sure to be safe.

These rules must be defined during the design of the process plant and must be reported in the explosion protection document. Similarly, cleaning and maintenance procedures should be defined to keep the efficiency for all mechanical and electrical equipment.

Too often accidents happen only because, during the design of the plant, was not taken into account the various factors that can not only cause a primary explosion, but also a secondary chain reaction, much more dangerous and devastating of the first.