

Analysis on Technical Feasibility of Drug Dust Recycling in Pharmaceutical Process

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ABSTRACT: Drug dust is often produced in pharmaceutical workshop process such as ingredients, grinding, granulating, packaging and tablet. Due to the chaotic spread of dust, workers' health and the safety of the surrounding environment are affected. When the dust concentration reaches a certain value burning explosion occurs. Effective recovery of drug dust can achieve production safety and the dual goals of environmental protection for enterprises and obvious economic benefits. Comprehensive analysis the dust control technology, dust removal equipment and filter the types of filter material and applicability. Considering the characteristics of drug dust and production requirements based on the analysis of dry and wet method in recycling technology solutions to clarify the technical feasibility of drug dust recycling methods. On the premise of guarantee the effective powder ingredients, how to determine the cleaning cycle is one of the key links to realize drug dust recycling.

KEYWORD: Dust removal technology; Dust removal filter material; Powder recovery; Recycling way

1 INSTRUCTIONS

Drug dust is generated in the ingredients, grinding, granulating, packing and so on. Its raw materials, semi-finished products and finished product which are various, not only have the general characteristics of the dust, but also have a specific performance of drug toxicology. A certain degree of harm can be caused to the occupational health of workers by long-term exposure to drug dust [1].

As the drug dust has sensitization nature and combustion hazard, violently explosion happens as long as there are enough energy sources. As burning explosion accidents of combustible dust sometimes occur, the serious casualties and economic losses are caused. The controlling and effective recycling of drug dust are effective technical means to prevent dust explosion [2].

Some important problems of occupation health, fire blast and urban public safety caused by excess concentration of pharmaceutical dust cannot be solved by dust comprehensive prevention and control technology in pharmaceutical workshops. The emission of drug dust should be controlled from the source as well. These technologies improving the increasingly serious air pollution also have vital significance. Due to the purification technology to recycle drug dust in workshops, the dual goals of safety production and environmental protection will

be achieved. Otherwise, the obvious economic benefits and social benefits will be brought.

2 APPROPRIATE SELECTION OF DRUGS DUST RECYCLING TECHNOLOGY

Aiming at the particularity of drug production, pharmaceutical workshops are required to comply with the requirements of "drug production quality management norms" (GMP). Independent negative pressure system should be designed at the place producing dust and a dedicated buffer room should be established to prevent drug dust spreading outside the production site [3]. The amount of drug dust and active residues in workshops can be controlled effectively if the operation of the production equipments and cleaning of machines are automatically accomplished under the closed condition [4]. The powder leakage can be controlled by these measures which greatly protect the environment and the safety of the production and personnel [5].

The bag filters remove dust by the filter elements. The bag filters have high removal efficiency, strong adaptability and flexible usability. The filtering effect of the cartridge filter can reach micron grade. The operation and maintenance of the automatic off-line ash-clearing, local collection and local

processing are fit for the removal with a variety of independent or multiple dust production points [6]. The feasibility of effective recycling of drug dust is provided by the bag filter.

As the requests of environmental protection are enhanced, the requirements of the filtration efficiency and service life of filter materials becomes stricter. The gradient structure of filter material is made of multi-layer fabric and base fabric by superimposition needling. The low running resistance and high filtration efficiency are great innovations of the manufacturing process of needled felt [7]. In the 1970s, the expanded polytetrafluoroethylene (PTFE) membrane with stable chemical performance was made by the Algore Company in United States. It can be overridden on the different filter materials to make up the coated filter material. The coated filter material has a low and steady resistance. Dust on the coated filter material can be cleaned easily [8]. The filter bags made by Dura-Life medium with smaller gaps have stronger load ability on medium surface and longer service life, which cost more [9].

At present, there are a lot of progresses in the drug dust control technology and the study of recovery methods.

3 ANALYSIS ON RECOVERY FACTORS OF DRUG DUST

3.1 *Properties of drug dust*

Drug dust has the characteristics of small density, small average particle size, large discrete degree and the high diffusivity. Because of the pharmacological properties, drug dust may have toxic harm to the human body, which causes allergy and stimulates eyes and skins. Some drug powder can be dissolved in water or slightly soluble in acid or alkaline solution. Drug dust has charge performance. The charge capacity is affected by particle size, density and the temperature and humidity of environment. Some drug dust is sensitive to the electrostatic ignition. The violent explosion happens when the energy of ignition source is enough [10][11]. The composition of drug powder has the period of validity, which needs certain environment. The efficacy will be lost with exposure to air for long time.

3.2 *The technical requirements of drug dust production environment*

Because drugs are produced in clean workshops, the design of the workshops should meet the requirements of Pharmaceutical manufacturing quality management specifications (GMP). The ventilation and air conditioning is asked according to the clean workshop design specification.

Air purification measures must be taken in the process of drug production in order to achieve certain cleanliness. In the pharmaceutical clean room, the air purification technology is used to control and remove the pollution of medicine. The level requirements in the clean space are reached by providing sterile air, taking reasonable airflow organization, controlling differential pressure and other comprehensive measures. The air clean degree of GMP in pharmaceutical workshops can be achieved by two measures. First, the schemes of inlet and exhaust layout should be demanded reasonably to effectively control the differential pressure and return air in pharmaceutical workshops. Secondly, the airflow with dust should be purified. After purification, the valuable drug dust can stay in dust collector.

3.3 *Recycling cycles of drug dust*

The dust collection cycle refers that the drug dust is recycled within the validity period. The recycling cycle is different from the soot cleaning cycle. Otherwise, the recycling cycle depends on the drug kinds and the surrounding environment.

(1) To recycle drug dust by dry method, the validity period needs be determined. In addition, the factors, such as the ambient temperature and humidity, need to be taken into account. The effective powder deteriorates after becoming damp. The acidic surrounding environment counts against the alkaline powder. The active ingredients of some powder are volatile under light.

(2) Besides determining the validity period of the drug ingredients, whether the solvents have effect on drug powder when taking the wet method to recycle drug dust. To some powder, water can be selected as the solvent. However, after the absorption, the drug powder needs drying and extraction, which may shorten the validity period of powder.

4 THE COMPARISON OF THE FEASIBLE TECHNICAL SCHEMES OF POWDER RECYCLING

4.1 *Analysis of dry recycling technology*

The filtering medium of the bag dust collector are chosen to recycle drug dust. The coated filter material made by PTFE membrane has vertical network structure to resist stretching, which is suitable for ash removal with high kinetic energy. The more stable chemical performance of the coated filter material made by PTFE membrane ensures the effective composition of the drug dust.

The pulse injection and vibration ash cleaning are two ash removal modes of the bag filter. Pulse injection is propitious to the flexible design of the filter bag and the manufacture of units with all kinds

of air volume. Vibrations from the net type filter cartridge filter dust removal with unique screen can be the first through the coarse dust catcher on the surface, the “melt filter “beforehand can withstand larger dust load [12]. Save the effective period before reach at highest efficiency than the bag filter.

Problem to be solved mainly in the pharmaceutical in recycling used in bag filter dust

(1) Although the effect of pulse blowing ash removal mode is good, drug dust is extremely small may not be able to blow or can't formation of dust layer in filter bag at the beginning, and it may be fully mixed with air and the explosion limit.

(2) Powder active ingredients have validity; Soot cleaning cycle must be controlled during the validity period of powder. But clear ash could not be broken at the beginning of the dust layer, a soot cleaning cycle at the beginning of the dust layer after the treatment to be solved.

(3) Under the condition of the filter resistance allowed lengthen soot cleaning cycle theory is used for reducing the amount of compressed air and wear and tear of the system components, but in order to ensure the effectiveness of the powder composition, to soot cleaning cycle must be less than the effective time of powder composition, so how to clear the ash cycle control in the most appropriate time to be further analysis.

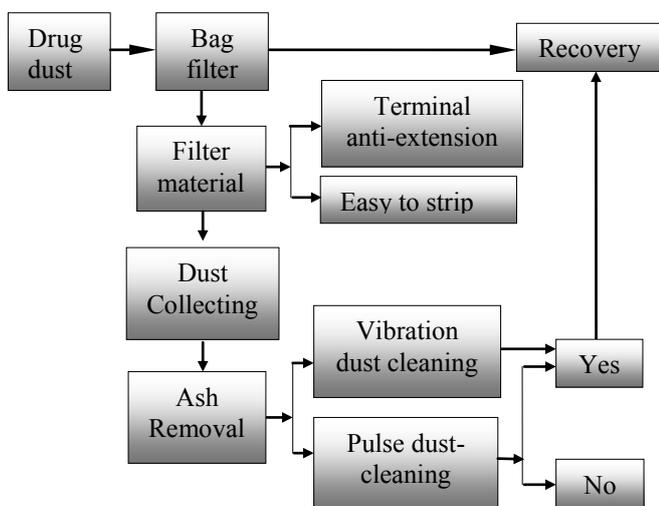


Fig1 Recovery technology route of dry type by bag filter

4.2 The feasibility analysis of wet solvent recovery methods

As the drug dust has charge performance and toxicity, some solvents are used to recycle the drug powder directly to reduce the exposure time the air, which ensures the effectiveness of the powder ingredient and reduces the occupational hazard to workers.

The filter bag should be plug-in type which can be used as storage and store drug dust collected. Constant resistance can be kept to efficiently collect

drug dust. Otherwise, the installation and replacement become simple [13]. Surface of the filter material becomes smooth after being processed or coated and the dust can be cleaned up more easily.

The main problems in the process of solvent recycling technology:

(1) The filter bag filled with the drug powder collected may be washed by solvents directly to achieve the purpose of ash removal by absorbing the dust. The soot cleaning and resolution should be accomplished in the validity period of drug dust.

(2) The solvents should not react with drug powder and be propitious to recycling. The solvents should be cost-effective and have less impact to the environmental.

(3) The effect of solvents to the filter material should be considered. The service life of filter bags may be shortened by the corrosion of solvents and the filter material corroded will influence the active ingredients of drug dust, which should be avoided.

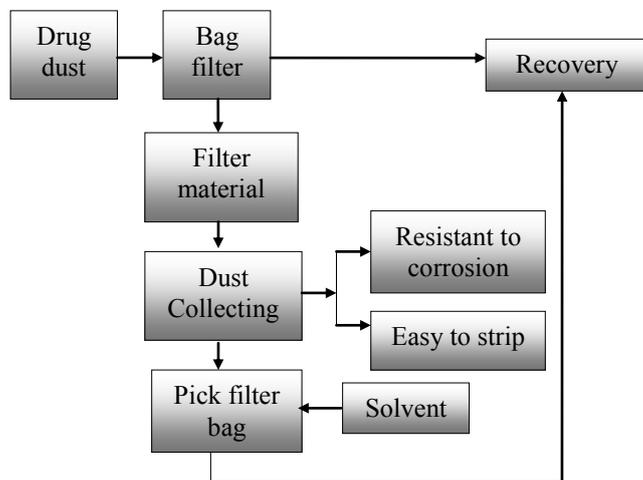


Figure 2 Recovery technology route of wet type by Solvent

5 CONCLUSION

This article discussed the feasibility of dust recovery using dry method and wet method and a discussion on recovery plans. Although dry method of recycling is simple, the explosion will be observed when the concentration of drug dust reaches a certain value. The dust cleaning using pulse jet is belongs to one of the high kinetic energy dust cleaning system. Powder properties, wear resistance and stripping ratio has to be considered when selecting a filter material. The main problem for wet method of recycling is how to choose the appropriate solvent to absorb the drug dust. The following features must be considered when we selecting the type of filter material.

Different from general dust, drug dust composition have validity, recycling is meaningful only in the effective time.

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