6.2 Source of Dust

6.2.1 Introduction

The pulverization or crushing which fragments a solid material by mechanical force and makes fine particles is the oldest mechanical operation of humankind. By this operation, the handling of solid becomes easier and the rate of reaction and dissolution and the catalyst reactivity are improved because the surface area of solid is increased [1]. These effects are readily seen in such processes as coal pulverization in the pulverized coal combustion facility and ore processing in the puddling. Also, the polishing is an operation to smooth out the surface of solid materials [2]. The particulate material that is generated and scattered during smashing or other mechanical operations, or associated with the accumulation of the materials obtained through these processes, is called the dust and is attracting attention as a source of air pollution.

The major source of dust includes the pulverizing equipment, polishing machine, sieve, particulate transport facility, pile of ore or soil, and cokes oven. Generally, the size of dust generated by the mechanical operation such as pulverization or crashing is relatively large and is about a few μ m and its range is rather broad, unlike the fine fume generated by the chemical reaction.

6.2.2 Pulverization or Crushing Process

(1) Pulverization or crushing Process

There are various types of pulverization process including the mining of materials of cement, limestone, coal, etc., crushing of clinker in the cement factory, production of pulverized coal in the pulverized coal burning power station, production of materials for glass, material preparation for china and porcelain, production of aggregate to use construction of building, waste treatment, and so on. Also, the type of pulverization or crushing equipment is diverse.

(2) Pulverization or Crushing Equipment [2) 3)]

The pulverization or crushing equipment is categorized into three types according to the type of force that the machine exerts on the solid to crush it finely. That is, the equipment that uses pressure by sandwiching the material to be crushed between two surfaces, the one that uses impact by hitting the material with a hammer so that it is crushed instantly by a high speed collision of a hard body, and the one that uses shear force exerted perpendicular to the direction of sear force [2) 3)].

(Rough Crusher) [2)3)] ; The rough crusher is appropriate for pulverization or crushing the solids of 1,500-100 mm to a size of 500-25 mm, and includes the jaw crusher, gyratory crusher, crushing roll, impact crusher and disintegrator [2]. The jaw crusher is a machine which crushes solid materials by a strong pressure applied between a fixed jaw and a reciprocating movable jaw as if human masticates foods by mouth, and is also called the masticating crusher. The gyratory crusher is also called the revolving crusher, and crushes the material by rotating and gyrating a conical rotator eccentrically set within an inverted conical ring to constantly change the distance between them and supplying the

material to be pulverized or crushed from above [3].

(Medium Crusher) [2)3)] ; The medium crusher is used to pulverize or crush solid materials of 500-6 mm to a size of 50-1 mm, and includes the cone crusher, roll mill, hammer mill and disk mill. The hammer mill is an impulse crusher which pulverizes or crushes the material by hitting it with a high speed hammer.

(Fine Crusher) [2)3)] ; The fine crusher pulverizes or crushes solid materials of 12.5-1 mm to a size of 2-0.1 mm, and includes the conical ball mill, tube mill, rod mill, roller mill, stamp mill, edge runner, vibration mill, and impact mill.

(Super-Fine Crusher) [2)3)] ; The super-fine crusher is used to pulverize or crush solid materials of 6-0.1 mm to a size of 0.1-0.001 mm, and includes the hydrodynamic energy mill, colloid mill, and friction disk mill.

(Shearing Machine) [3)] ; The shearing machine includes the knife cutter, rotary cutter, and screw cutter.

6.2.3 Polishing Process

Polishing is an operation that finishes the surface of material by using the polishing machine such as the belt sander, drum sander and wide belt sander. The belt sander polishes the surface of material by moving the polishing paper or cloth with 2-4 pulleys. The drum sander polishes the material by rotating a cylinder, wrapped around with the polishing paper or cloth, at high speed.

The wide belt sander is a machine to polish the material by upper and lower drums wrapped with an endless polishing paper. These machines are used in the factories for paper and pulp manufacturing, furniture manufacturing, and plywood manufacturing, and produce dusts [2].

6.2.4 Sieving of Particles

The sieve discriminates between smaller particles, which pass through small holes, and larger particles, which do not. It is used to classify the dust that corresponds to a mesh of the sieve by moving the dust on it. The mesh and thickness of the sieve are specified by the Japanese Industrial Standard (JIS). If the dust is classified by stacking a sieve with a larger mesh on another sieve with a smaller mesh, its particle size distribution can be obtained.

For industrial purposes, the rotation sieve which has a sieve of cylindrical wall and the flat sieve which uses a moving flat sieve are used. The dust is generated at the particle feed portion, on the mesh of a sieve, and at the particle discharge portion. The protection measures such as a cover and a dust collecting equipment are installed.

6.2.5 Transportation of Particles [2]

For the transportation of particles, belt conveyers and bucket conveyers are used, and they also scatter dusts. The belt conveyer is a transportation facility which has an endless belt stretched between two pulleys on both ends of a frame and transfers loads on the belt by moving it continuously. This facility is quite economical for transporting loose materials such as coal, ore, or gravel, but sometimes accompanied by dust scattering. Also, the bucket conveyer is a facility to transport loose materials from the lower to higher positions vertically or at a steep

angle. Buckets are attached at a constant distance to a chain or a belt stretched upward, and loose materials thrown into the bucket are continuously transported upward. When it is used for transporting dusts, they are scattered around. The protection cover is installed or the dust is collected by a dust collecting equipment while arranging an enclosure hood.

6.2.6 Pile of Particles

Industrial raw materials such as coal and ore are often stored in the open air as a pile, but some are lost through the scattering of dust. For instance, it is reported that about 6.4 mg per 1 kg per year will be lost from the pile of coal. Also, about 13.2 pounds (1 pound=0.4536 kg) per acre of pile area (1 area=4046.6m^2) per day of rock and gravel is reported to be lost from the rock pile operated 24 hours a day [2]. Measures such as the water sprinkling or the chemical sprinkling by a sprinkler are used.