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A NEW TYPE OF DUST RESISTANT SILENCERS

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1. INTRODUCTION

In the food–grinder workshop powerful fans are used for transporting grain and its flour. Noise level from air–flows of these fans is very high. In a distillery, measurements have been made with sound lever meter and filter set. The level at an exhaust is 107 dB (A), whose octave band analysis is shown in Fig. 1(a). It can be seen that this noise frequency spectrum has broad band.

The air–flow through the fan carries not only noise, but also a large amount of dust, most of which consists of flour. Under the existing conditions common type of silencers are ineffective. To illustrate it, the common type of dissipative silencers are made of absorptive materials which contain a large number of small interconnected air passages in which sound–absorbing processes take place , when air passages are filled with dust, then attenuation produced by silencer is dropping off rapidly. The common reactive silencers, such as the expansion chamber and the Holmholts type, have good dustresistant characteristics, but their attenuation–frequency band is too narrow to meet the need of the control fan noise.

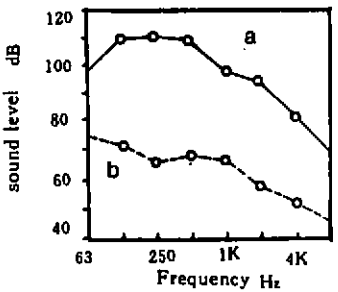

Fig. 1 frequency spectrum of fan exhaust noise

From what has been said

above, it can be seen that the design of new type of silencers is necessary.

2. CONSTRUCTION OF THE SILENCER

There are two centrifugal exhaust fans which work alternately and one discharge fan is this workshop of distillery as mentioned above. In order to cut down expenses and to be managed conveniently, three fans use one and the same silencer, which is put on the roof of the workshop.

The appearance of the silencer is similar to letter L. Its perpendicular part is like a common splitter silencer, but absorptive materials used are unlike completely. In the new silencer there are no porous materials but, instead, airtight plastic small boxes which are called Thin—plastic—box Absorber in China. they are made of modified PVC plastic sheet about 0.3mm in thickness. When these boxes have been attacked by sound waves, all the surface is resonant and acoustic energy is converted into heat. In consequence, the air—flow noise level is reduced considerably. Since there are no holes in these boxes, dust can not intrude into their inner, and the surface of the boxes is in vibration, which stops dust from piling up. Therefore, these boxes have good property of protecting against dust.

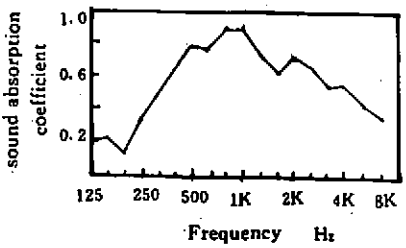

Fig. 2 sound absorption characteristics of Thin—plastic—box Absorber

The sound absorption coefficient of the boxes has been measured in the reverberation chamber as shown in Fig. 2[1]It can be seen that these plastic boxes have good sound—absorbing performance over a broad band of frequencies.

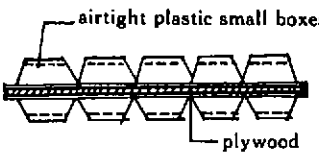

Fig. 3 showing one piece of an absorber

Dimensions of an unit which consists of 30 boxes are about 500mm, six units constitute one piece of an absorber and they are fixed to a 7mm plywood in order to be installed conveniently (see Fig. 3).

The acoustic performance of the silencer is concerned with not only the absorption coefficient of the boxes, but also the width of airway.

Reducing the width of airway will improve sound characteristics, particularly at high frequencies. Reducing the width of airway will also cause an increase in flow velocity and so cause an increase in the amount of self — generated noise. Thus, there is a reasonable space between splitter silencer sections, which are arranged at intervals of 220mm by experiment.

The transmission loss L_{TL} may be estimated by the following formula

$$L_{TL}=\varphi(\alpha)\frac{p}{S}L \qquad dB,$$

where $\varphi(\alpha)$ is a function of sound absorption coefficient; $\frac{p}{s}$ is ratio of perimeter to cross—sectional area of airway; L is the length of silencer.

The horizontal part of new silencer is like an expansion chamber of silencer, but three baffles are added to prevent ineffectiveness at high frequency. To improve attenuation performance, all inner surfaces, except the bottom, are covered with thin perforated sheet steel to protect against being worn away and the thin plastic film is used to protect against dust. Except the door, the bottom of silencer is smooth and slant so as to clear away dust deposit easily.

At the bend of the silencer a sudden change in acoustic impedance will cause sound to be reflected back so as to reduce noise. Likewise, a sudden change in the direction of airflow will cause some of dust to sink.

The power level of ejection noise Lw depends very much on the air jet velocity v. The relationship is as follows:

$$L_w=10\lg s+80\lg v-45 \qquad dB$$

where s is the area of nozzle. As it is known that the greater the s the lower the v under the same air—flow. It is obvious that the increase in area of nozzle will lead to the reduction of ejection noise. That is the reason why overall width of silencer is designed in 2200mm

3. RESULT OF APPLICATION

This new type of silencer has been made by Yaulun Metal Products Co., Ltd. One of them has been fixed in the food—grinder workshop of distillery for more than three years and the air — flow noise has been reduced from107dB (A) to 69dB(A), whose octave band analysis is also shown in Fig. 1(b). Besides noise, dust pollution has also been controlled effectively. People living near the workshop have not any pollution problems any longer. They say happily that they have a clean and new world now.

References

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