The position design of drying fans in different grain drying processes

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Abstract

The paper discusses mainly the position design of drying fans used in different grain drying processes and the position effect on the result of grain drying. The advantages and disadvantages of different positions are both discussed with some precautions given. The conclusion will be beneficial to the designers who are engaged in grain drying practice.

Introduction

Drying fans are undoubtedly one of the key equipment for grain drying processes, because of the difference between drying processes, the position design of drying fans shall not be always the same. When holding some fans at difference positions, discrepancies will take place to a large extent among the effects of these fans on the performance of dryers used. Drying fans in a dryer-processing line, in fact, are mainly used to charge and transfer continuously the drying medium into a grain dryer with certain pressures, thus making the medium to penetrate into grain layers and to exchange/convert heat in grain. Finally, grain is dried up after the moisture contained in grain has been removed off through heat transfer. So, the position design of drying fans depends on which drying process the grain dryer shall use and, on the other hand, these designed position of drying fans will have some important effects on the drying result of the dryer used. So, we shall attach full importance to the position design of drying fans.

Although the grain drying processes differ from each other, the position design for all drying fans in a dryer-processing line can be generally divided into three types, i. e , Types A, B and C, Type A: the fan is positioned in front of heat exchanger, see Fig 3. Any two of the three types or all the three types can be used in combination, e g. the mixed-flow type dryer line in the grain depot in Yushu County, Jilin Province, China, which was supplied and built by LAW Co. in France, see Fig. 4

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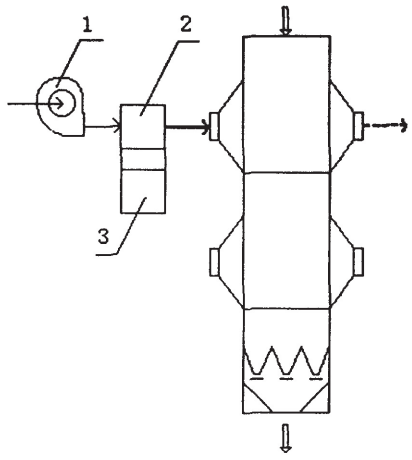

Fig. 1.
1 drying fan 2 heat exchanger 3 burner

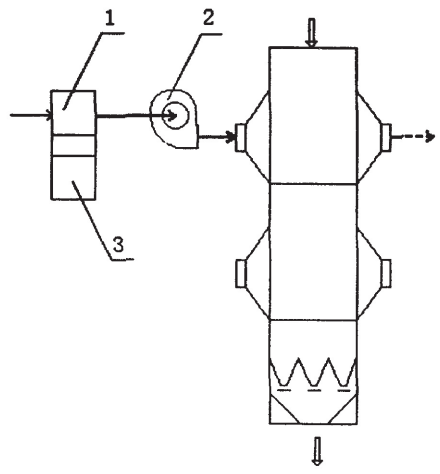

Fig. 2
1. heat exchanger 2. drying fan 3 burner

Position Design In View Of Drying Process

The drying medium used in Type A can only be of the same temperature, and it applies to all comparatively simple drying processes with its wide applicability, such as the mixed-flow type dryer commonly used in China. The cross-

flow dryers, such as the Berico mesh-column dryer and Zimmerman cylindrical dryer, also belong to Type A. The temperatures of the drying medium used in Types B can vary with the increasing number of fans used so as to fit in with different temperatures necessary for different drying sections and further to get optimum drying result, such as most of the concurrent-flow type dryers which have been developed rapidly at home and abroad As for Type C, it is rarely used singly and, in general, used in combination with Type A. The combination of Type A with C requires more complicated drying processes with more variations and higher technologies provided So, it will be hard to put into effect. However, it will improve the drying processes greatly and be the solved well

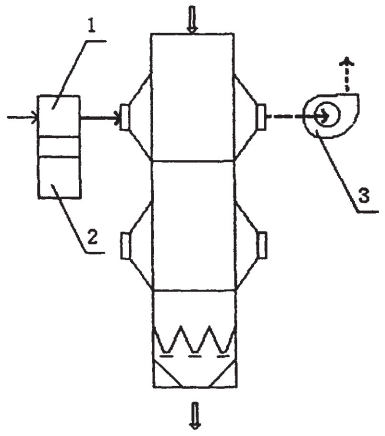

Fig. 3
1 heat exchanger 2 burner 3 drying fan

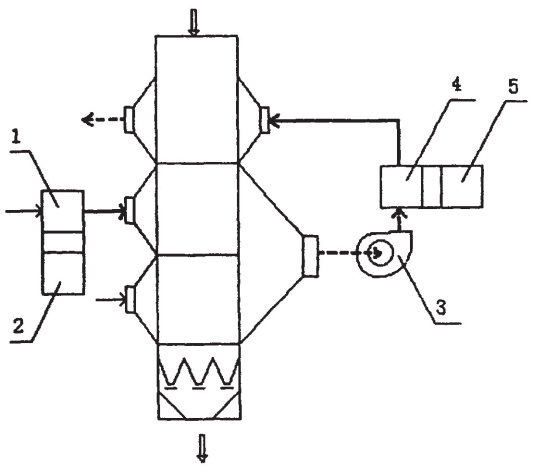

Fig. 4
1 heat exchanger(1) 2 burner(1) 3 drying fan 4 heat exchanger(2) 5 burner(2)

Position Design in View of Energy-Saving

In this respect, Types A is the best, B the next and C the worst. But, a combination of C with A is more ideal drying process. Most of such combinations are of the type of waste heat recovery/utilization with favorable energy-saving effect available. For example, as shown in Fig. 4, the LAW dryer made in France is quite good in energy-saving because there are two sets of heat supply provided for its drying process and drying fans are arranged according to both Types A and C with drying and cooling functions both provided The air exhausted from the 2nd drying section and the cooling section is blown into heat exchanger by fans to heat it up and then comes into 1st drying section of drying column An important warning must be given to the waste air that a dust explosion is possible if the dust contained in waste air is precipitated in heat exchanger for long without being filtered and removed in due time. For example, the LAW dryer adopts a method of discharging grain intermittently, i e. utilizing the negative pressure produced at the moment the grain discharge operation is just stopped to purge off the dust from filtering screen In this way not only the blocking due to the dust adherent to filtering screen can be cleared off but the dust can not enter into the heat exchanger. It is indeed a model of energy-saving in drying process

Cost comparison

Type B is expensive to its manufacture because the drying fans used shall provide relatively high heat-resistance able to stand against the high temperature of drying medium which has already been heated to higher temperature before entering into fans (over 140℃ in general) However, Type A fans will work at normal temperature and the temperature of waste air passing through the Type C fans is about 50℃ If follows that Type A and C will be of low cost because common fans can be used there

Comparison of power requirements

Under conditions that the weight of airflow or drying medium used is constant, the higher the temperature of medium is, the more the volumetric airflow will be needed. Correspondingly, high-capacity fans will therefore be needed to provided higher air flow rate with power demand and cost both increased For example, a comparison is made under conditions that the weight of airflow is constant The air density is 1 2 kg/m^3 when the standard temperature is 20℃ for the design of Type A fans. But, the air density is 0.83kg/m^3 when the temperature of drying medium or airflow is 150℃ for the design of Type B fans, i e only 69% of weight of airflow can be blown out by the fans in Type A. According to our practice About 40% of power

consumption can be saved on if using Type A fans

Position Design in View of Safety

In general, the flue gas will draw in air with its negative pressure during the heat exchange of flue gas with outside air when the heat exchanger is working. What may be different is just the form of the outside air into the heat exchanger. Type A fans blow out air with their positive pressure. But Type B and C fans draw in air with their negative pressure. If using Type A fans, the flue gas will not be blown into the drying column but drawn off through gas flues by draft fans even an internal leakage takes place in heat exchanger, since a positive pressure is kept within the whole circuit of drying medium. In Type B and C, however, the flue gas and sparks will be drawn off and then blown into the drying column by fans in the event that an internal leakage takes place in heat exchanger. Thus, not only the grain to dry up will be contaminated but also a peril of fire will be hidden in the dryer. Designer should pay full attention to this problem In sum, Type A drying process is comparative ideal in view of safety.

Conclusions

The position design of drying fans depends on what drying process is used. But, when making a decision for drying process the position of drying fans in process flow shall also be taken into special consideration. Under certain conditions, there is a comparatively high flexibility of the positions chosen for drying fans in design, of which the technologies, economy and safety shall be considered all-sided so as to play fully the role of dryers. The combination-type drying processes will show their the scientific and technological progress and social development. Paying special attention to quality and economic benefits, saving on energy and reducing the cost of grain drying operation are our general consensus, and we trust that the grain drying industry will develop rapidly in China.