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Lampblack Pollution and Control Measures in China

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Abstract

In the recent year people rise the momentous concern about their health as well as environment and its pollution. Human health is struggling extreme persecution that created by means of burning fossil fuels and pour polluting chemical waste into the residing environment. Exposure to cooking fumes has anecdotal degrees of harmful effects on human health and also helps to enhance the environment pollution. Organic mixture of smoke resulted by the thermal decomposition of food cooking process. Smoke generates from traditional food catering practices is one of the broader stage of pollution that badly affects the natural environment. Oil smoke emission is also widely exceeded with the continuous development in food and beverage industries that is not only destruct the environment also causes the residents who is live near or surrounding of industries. In this paper point out the oil smoke generation hazard, lampblack pollution and suggest control measures.

Keywords: Oil smoke; Generation hazard; Lampblack pollution; Control measures

Background

Smoke generation and harm

Traditional cooking method is to heat the edible oil at a very high temperature to make a food; the concentration of oil smoke produced in the cooking process is much higher that is not favorable for human health.

The oil fume formation is divided into three stages: First, edible oil is heated at the temperature of 50-100°C, due to low boiling point component and water vaporization surface of the edible oil has slightly rise the heat and also not visible for naked eye [1].

After that, food added at high-temperature edible oil, food moisture suddenly vaporized out of the oil surface and water vapor touched the surrounding cold air, due to rapid condensation oil smoke generate from the production of small oil droplets [2].

Finally, heated the oil up to 300°C to cook the food, due to very high temperature carbohydrates, proteins and fats are reduced to toxic products such as aldehydes, ketones, alkanes, polycyclic aromatic hydrocarbons and other organic compounds which can irritation of airway mucosa [3].

Food and beverage fume exhaust gas through a series of huge chemical reactions generated by volatile substances and other polycyclic hydrocarbons are chemically toxic, will infringe the body's internal organs and immune function.

A case study in Sweden shows that even short-term exposure to food and beverage fumes can affect the human body. After 2-4 hours of exposure to the fume, inhaling small particles of fume particles can cause blockages in the airway at the end of the bronchus, and this effect lasts for some time before it can slowly recover [4].

Methods

Facing the serious threat of oil smoke, domestic and foreign experts have done a lot of research on oil smoke control, put forward a lot of practical methods, at the same time, countries have promulgated a large number of relevant standards to control oil smoke emissions.

Although there is no fully uniform testing standard in the United States, the air quality control zone on the South Bank of California has developed the first test method for particulate matter and volatile organic compounds in fumes, which is widely used in practical testing to regulate oil smoke emissions [5].

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China's Environmental Protection Administration also issued on July 1, 2000, "Catering industry oil smoke emission standards (trial)" (GWPB5-2000). In September 2001, the promulgation of "catering industry oil smoke purification equipment technical requirements and testing technical specifications (Trial)" (HJ/T62-2001).

These standards stipulates the technical requirements and testing techniques and testing rules for removing efficiency and other functions of oil smoke purification equipment in catering industry, and is widely used in the treatment of oil fume purification equipment.

Foreign oil smoke treatment method

The cooking methods of foreign catering industry are very different from those of country like china, and the use of edible oil is less and the pollution level is not too large. Most large hotels will take thermal oxidation incineration method. Small and medium-sized hotels mostly adopt catalyst purification method.

Thermal oxidation incineration method

The mechanism of oxidation incineration is to convert the harmful components in the oil flue gas into safety components through the oxidation reaction of the heat propulsion, so that the whole material burns completely, while the thermal efficiency is the best, and the NO_x emissions are the least, for example, Sterling Asia developed a successfully patented multistage combustion system, Able to efficiently handle the exhaust gas in the catering industry while using the waste heat generated by incineration to heat cooking oil, to achieve the goal of efficient use of heat, both economical and environmentally friendly.

But the technology is complex, the equipment is huge, the combustion temperature is high, needs to consume the additional auxiliary fuel, increases the occupation to the resources and the energy, the cost is relatively high, does not apply to the small and medium-sized restaurant.

Catalyst purification method

Purification Method is the adoption of a variety of synthetic catalysts, so that organic matter under the action of the catalyst at a lower temperature (generally around 300°C) under the production of flame-free combustion to produce carbon dioxide and water and other substances [6]. In this process, the role of the catalyst is to reduce the reaction activation energy. It has been reported that the Germans invented the "kitchen fume filter Decomposition device", using catalytic combustion method to treat oil fume, to achieve a more reasonable effect. The method has high efficiency and low reaction temperature, which reduces energy loss to a great extent. However, at present, the catalyst purification method has no application examples in China, and only the simulation research is carried out in the laboratory.

The selection and use of catalysts is still quite difficult, the cost of synthetic catalysts is also higher, and the implementation of higher costs, catalytic bed on time maintenance is relatively complex, not yet compound China's national conditions.

Précis: The difference of domestic and foreign cooking methods, the difference of the scale of the catering industry, the difference of economic development degree and the difference of people's environmental protection consciousness make it impossible to popularize large area in our country by using the mature method in foreign countries.

Therefore, the development of purification methods in line with China's national conditions and economic effectiveness has become the focus of many experts and scholars to study.

Domestic Oil Smoke Treatment Methods

There are many methods to remove oil fume particles in China, such as cyclone separation, liquid washing, electrostatic deposition, activated carbon adsorption method and so on.

Cyclone separation method

The cyclone separation method uses the inertial collision produced by the cyclone to make a drastic transition in the direction of the flow of the oil fume, so that the particulate matter in the oil smoke gas reaches the sedimentary surface under the action of inertia and is detached from the airflow [7]. For example, Lin Jieli developed and studied a kind of impact flow high efficiency oil fume purifier, through the impact flow high-speed collision enhancement reaction mechanism of food and beverage oil fume for rapid purification treatment. The main advantage of the comprehensive cyclone collision separation method is that the equipment is relatively simple and the pressure drop is small.

The disadvantage is that the particle removal rate of smaller particle size is relatively low, and because of the large viscosity of particulate matter in the oil fume, the cleaning and maintenance workload is very large, so the implementation of the application is limited.

Liquid washing method

The mechanism of liquid washing method is that the oil flue gas is fully compatible with the absorbent liquid through a special gas arrangement device, and the particulate matter in the oil flue gas is removed from the gas phase to the liquid phase, which is usually used by spraying, water film and so on. The advantage of liquid washing method is that by improving the properties of the detergent can remove the SO_2 , CO_2 , NO_x and other exhaust gases in the oil fume, the area is relatively small, easy to operate and maintain, and there is no fire hazard. The disadvantage is limited by the function of wet dust collector, and the purification efficiency of sub-micron particulate matter is low [8].

Washing waste liquid cannot be better solved, generally directly imported into the sewer, easy to produce two of times pollution.

Electrostatic dust removal method

The working mechanism of electrostatic dust removal method is to substitute the oil fume into the high voltage electric field, which produces ionization and the particulate matter in the oil fume, moves to the dust collector under the action of the electric Field Force, and removes it from the oil fume when the dust collecting pole agglutination is deposited, so that the gas can be purified [9]. Electrostatic purification equipment mainly has two working areas, the front area of the discharge pole, known as the ionization zone, oil fume particles into the first charge.

After placing the dust removal pole, also known as the Dust Collection area, the charge particles are arrested in this area set. Electrostatic purification equipment has the advantages of compact equipment, small footprint, high purification efficiency, usually up to more than 90% [10], less pressure drop, low noise and energy consumption, low operating costs. The disadvantage is that because dust collector pole viscosity is relatively high, resulting in

the formation of oil film layer, so that the purification efficiency is reduced, and dust collection pole washing difficulties, maintenance workload, there are fire hazards. For example, Guangdong Mori Environmental Protection Engineering Equipment Co., Ltd. developed an electrostatic catering oil fume purifier and applied for a patent, which is characterized in that the oil fume purifier includes equipment controller and equipment reactor, in practical application, has played the advantages of high processing efficiency, less energy consumption, so it has been popularized. The development of the high-efficiency catering electrostatic oil fume purifier, including the front section, the transition section and the rear section, is developed and studied.

Among them, the front section includes the first discharge pole, the second discharge pole and the first grounding pole, the rear section includes the third discharge pole and the second grounding pole, through the multi-layer discharge, achieves the high efficiency dust removal effect.

Activated carbon adsorption method

Activated carbon adsorption method is to let oil smoke through the adsorption filter layer, adsorption of oil smoke in the small granular aerosol [11]. The advantage of this method is that when the installation is just beginning, the adsorption effect is good, the removal rate of aerosol can reach 40%~70%, and it has obvious effect on the purification of odor.

The disadvantage is that with the adhesion of oil smoke, adsorption capacity will gradually weaken, must often replace the filter material, high operating costs, and because the wind resistance is too large, so that the works of oil smoke in the workplace is poor, it is necessary to increase the wind turbine air volume, in order to prevent noise pollution.

Compound method

Compound method refers to the organic combination of various purification methods. From the point of view of governance effect, the composite method is the development direction of oil fume purifier in the future. At present, the common inertial, electrostatic combination, wet, electrostatic combination and other methods, especially the combination of wet and electrostatic applications, the advantages of the two methods complement each other, promote each other and resist each other may produce two of pollution. Electrostatic treatment can efficiently deal with large particulate pollutants in oil fume, so that the treated flue gas basically meet the international requirements, although it cannot effectively remove small particles of pollutants and gas molecules, but can be fully charged, improve the subsequent effect of water spray treatment [12]. The sprinkler treatment area uses the charge mirroring force between charged particles and ions and zero potential objects to enhance the dust removal effect, which makes a relatively complete purification of the pollutants that are difficult to deal with in general Purifiers, reduces the two pollution of circulating water, and reduces the inevitable waste of electrostatic precipitator-ozone [13].

Précis: Although there are many domestic research methods, but each method has advantages and disadvantages, and domestic because of a lot of equipment cost, effective action time is short, equipment structure is complex, maintenance costs are high, coupled with people's awareness of environmental protection is not enough, many equipment only pay attention to the removal of particulate matter, do not care whether to produce two pollution. Therefore,

this topic considers the development and research of a compound purification treatment method.

It makes the processing efficiency high, the operation is stable, the investment is less, the footprint is small, the operation management cost is low, and the operation maintenance is simple.

Causes and Control Technique of Oil Smoke

At present, large and medium-sized catering enterprises oil smoke treatment emissions usually have the following problems.

Poor equipment purification effect

At present, the restaurant industry shopkeeper environmental awareness is weak, whether it is equipment fees or operating costs are not willing to invest.

Some are under pressure from environmental checks to install oil fume purification devices, but only fixtures, may only operate during environmental inspection, do not check when the purification equipment to reduce operating costs.

Many catering enterprises smoke purification equipment to reduce the special washing, maintenance, often after the installation of equipment has not been cleaned, after a period of operation oil smoke purification treatment efficiency reduced, and eventually lost the purification function. In view of this problem, one is to speed up the development and promotion of cost-effective oil fume treatment devices, the other is to strengthen the enforcement of regulatory departments, and then to strengthen the environmental awareness of catering business operators.

For catering enterprises that have issued business licenses and do not have environmental protection approval procedures, the Environmental Protection Department has ordered them to close down and make up the relevant environmental protection procedures for a limited period of duration.

Insufficient exhaust capacity of equipment

In the usual kitchen ventilation design, the design expectation of engineering designers is quite different from the actual results, and the ventilation effect is not good. The lack of exhaust capacity of fume discharge equipment will directly lead to oil smoke emission barriers; the large amount of fumes produced during frying will be stranded in the kitchen, and even spilled into the restaurant, directly affecting the health and mood of chefs and guests.

Therefore, the reasonable calculation of exhaust volume in the design must not be less.

Grease accumulation in flue

The accumulation of flue grease usually drips outward from the seams of the flue, affecting the normal production process, but if the grease in the flue accumulates too much and does not discharge in time, it may cause a fire.

When frying, once the flame is too high, it is easy to ignite the oil in the flue, and once the flame infiltrates the gas cover, it is also very easy to ignite the oil in the pipe, which will cause the flue to catch fire.

Therefore, fire protection problems should be considered in the design and installation of fume exhaust lanes:

(1) in the oil exhaust pipe vertical pipe and exhaust hood interface and exhaust oil pipe outlet treatment when setting fire valve, the disc is usually open, fire, the device can be taken manually or automatically,

close the disc.

(2) The design and installation of flue drains should be considered to drain the oil hole, through the oil discharge hole in time to discharge the oil in the pipeline.

(3) The installation of a firm exhaust oil pipe should be independently designed, cannot be placed on the wood, plastic and other combustible objects, the placement of smoke pipe and combustible objects should maintain a certain safe distance.

The bottom of the hood and the stove shall be maintained at a height of not less than 1.5m, to prevent the flame ignition pipe in the frying oil scale and fire.

Exhaust fan noise is too high

The fan will produce strong noise in operation, and its noise source is mainly the aerodynamic noise generated by the inlet and outlet, the mechanical noise of the chassis and motor, and the solid noise generated by its foundation vibration. According to Cao Ping survey, a number of urban district in Shanghai and restaurants spaced around 10m residential population measured fan noise in the ~72dB (A), more than the country on the day 65dB (A), Night 55dB (A) environmental standards, the situation is in urgent need of governance [14].

The management of stroke machine noise in urban catering industry is different from other industries, which has certain difficulty:

(1) The fan of the positive pressure system is mostly installed in the air inlet muffler, in the installation of sound insulation cover, but there are noise-cancelling instruments occupy a lot of space problems, small and medium-sized catering shops cannot be achieved.

(2) The fan muffler of the negative pressure system should also consider the problem of the muffler's own function, and the large amount of oil deposited into the sound absorbing material will reduce its durable life.

(3) Small and medium-sized catering industry and residential areas adjacent very close, noise propagation distance near, the impact of greater harm.

Small fans can have a greater impact on the noise of nearby residents.

Conclusion

In the view of development trend of oil smoke pollution control technology in catering industry, Firstly, more stringent standards should be formulated as soon as possible to control oil smoke discharge, on the other hand, it is urgent to carry out research to remove high efficiency, no two pollution, low investment and

operating costs, lower pressure drop and less energy consumption, simple maintenance management, Efficient new dust removal equipment for the space occupied. At the same time, keeping up with the footsteps of foreign research and developing new technologies such as photolysis and oxidation will also become the key research areas of new purification technologies.

Not only that, in the view of current situation in China and also to meet today's oil fume purification equipment market requirements for further research on the composite dust removal process.

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