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AIR TREATMENT APPARATUS OF HIGH CAPACITY

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Abstract. Currently, due to a sharp increase in the probability of large-scale forest fires in the territory of RF and EU pressing problem cleaning large quantities of air from the smoke to supply clean air kindergartens, hospitals, residential and others in emergencies. For a practical solution to this problem at Moscow State University of Environmental Engineering of design air cleaning apparatus.
The apparatus is a modular design, the basic element which is inflatable structures installed on the collapsible frame made of metallic elements. At the bottom of the unit located air intake box below which is located catchment. The module is divided into separate sections that can be implemented as a circular or polygonal cross-section. Inflatable construction unit shall meet within one hour. Delivery of air pollution control devices sections in any desired location of major fire fires to clear smoke from the air supplied to health, children and other living quarters in the state of emergency, can be carried out using a mobile air vehicles.

Keywords:.fires, emergencies, disasters, pollution, smoke, air cleaning, nozzle for heat-mass transfer processes, mobility.

1. Introduction

Over the past 10 years, Earth has fallen to a large number of environmental disasters, the most global of them:

- 1997–1998 years, the hurricane "El Niño" raged over many cities, the total damage amounted to $ 20 billion;
- 1999, an earthquake in Turkey by force magnitude 7.6 killed about 20000 people;
- 2003, Hurricane Isabel, named the most powerful and lethal, claimed several thousand lives;
- 2004, off the east coast of the Indonesian island of Sumatra occurred one of the most powerful destructive earthquakes in modern history, which arose after him a tidal wave killed about 300000 people;
- In 2005, the Pakistan earthquake with a magnitude of 7.6 points was the most powerful all-time seismic observation in South Asia, killing more than 100 thousand people;
- In 2008, the sudden awakening of the sleeping for hundreds of years the volcano Chaiten in Chile;
- April 2010, a volcanic eruption in Iceland, which has come aviakollaps in Europe (News 2011).

And in Russia in summer 2010 there was a global cataclysm, because of the steady heat began to burn peat bogs, which led to willfully not only the region but also the central part of Russia Fig 1.

Fig 1. Consequences of burning forests

Forecast MOE Russia in 2011 followed, again expected large wildfires in the Amur, Omsk, Sverdloskoy and Chelyabinsk regions, also in the Altai region, Orenburg, Ryazan, Volgograd and Moscow regions (Новости 2011).

Each year on Earth burn from 13 to 20 mm of hectares of forest. During combustion of forest stand carbon monoxide CO and CO_2. Combustion of one hectare of forest leads to the release of ~3 tons of CO_2. In this case, according to the UN Committee on the Food and Agriculture, 25 % of annual CO_2 emissions to the atmosphere as a result of deforestation and forest fires. Moreover, the share of fires account for 18 % of emissions CO_2 (Новости 2011).

Launched forestry, the absence of many rural towns, even the simplest means of combating fires, the lack of equipment units of the Russian Federation Ministry of Emergency Situations of modern firefighting techniques, showed that a systemic approach to the protection of peo-

ple and objects of life (schools, hospitals, kindergartens, etc.) as well as advance preparation for such a large-scale emergencies (Ясинский 2010). All of this suggests that it is necessary beforehand to create tools for mobile solutions emergencies. Need to create devices that will be able to clear large volumes of air from pollution, thus providing a clean air facility life. Need to create devices that will be easy during assembly and during transport.

2. Existing methods and apparatus for air purification

Used in industrial cleaning equipment and heat recovery from flue gases provides for various schemes of interaction between the flow and, therefore, use as a once-through and counter-contact devices.

As an effective equipment in the plant absorption treatment using packed vehicles. In these devices in a layer of nozzles provided better contact with the processed gas absorbent in comparison to hollow without nozzle spray (Мухутдинов 2007; Пушнов *et al.* 2010). The use of new high-performance nozzles allows for the intensification of mass transfer process and reduce the overall dimensions of air pollution control devices (Каган 2008).

When cleaning small amounts of flue gas (hundreds of thousands of cubic meters per hour) are preferred methods for cleaning ammonia. When cleaning large volumes of flue gas (millions of cubic meters or more per hour) it is expedient to apply lime and limestone cleaning methods.

Ammonia cleaning methods are:

- Ammonia method;
- Ammonia-sulfuric acid method;
- Ammonia-cyclic method;
- Ammonia-autoclave method.

Ammonia ways to clean gas streams characterized by high efficiency of the process, the lack of absorbent in the solid phase, preventing the normal operation of technological equipment. The disadvantage of this method is the appearance of a by-product, which is not in demand in the market.

Lime and limestone methods are simple flowsheets, availability and relatively low capital costs. The disadvantages of this method is the low utilization rate of lime and limestone - up to 60 %, the formation of by-product in the form of wasted sludge, a relatively low cleaning efficiency, clogging the absorption apparatus and communications crystalline deposits.

Also apply magnesite methods, ozone-catalytic and other cleaning methods.

All of these methods include the use of rather complex structures and not all are effective and accessible for cleaning large volumes of gases. It is therefore necessary to create a mobile, rapidly deployable, rapidly establish and collect, with quick delivery to the scene in the area of the objects for the life and work.

3. The scheme proposed air pollution control installation

We offer a technical solution to the flue gas cleaning involves the use of water as an absorbent of the available sources in the ignition (river water, etc.) in a countercurrent apparatus of gas-liquid interface. Possible addition to the specified absorbent intensifying components (additives). Scheme of air pollution install high-capacity shown in Fig 2.

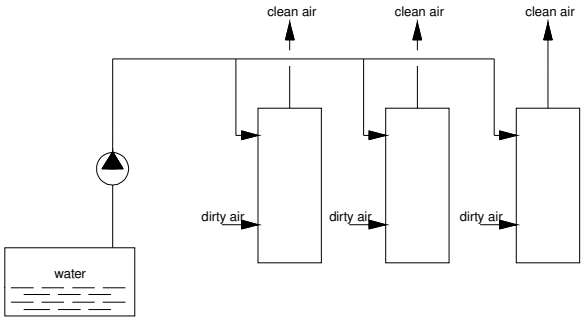

Fig 2. Install air pollution control scheme

Technological mode installation: Air flow w_0 = 3 m/sec.; Consumption of liquid Q_w = 10-40 m^3/h.

4. Description of the proposed technical solutions

The proposed modular unit shown in Fig 3.

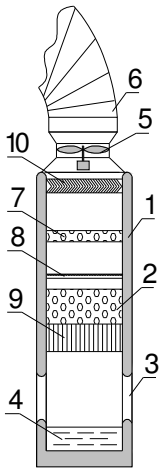

Fig 3. Proposed modular

Module air cleaning apparatus is a structure, la base which is a body 1 made of inflatable elements. Inflatable elements installed on the collapsible frame made of metal elements 2. At the bottom of the unit located air intake box 3, below which is located catchment 4. For supply of filtered air to the objects of life using an axial fan 5 Fig 4 placed at the top of the air cleaning apparatus.

The purified air is supplied to these objects using the conduit 6 made of plastic pipes. At the top of the device is placed baffle system of grooved type 7, see Fig 5.

For the process of cleaning the air in the machine nozzle is 8.9, performed in 2 layers. The lower tier is made of regular packing, see Fig 6.

The upper tier is loaded bulk metal nozzle type ГИАП-Н3 80 or 120 mm, or from the nozzle type N3C made of polymer material Fig 7.

Fig 4. Axial-flow fan

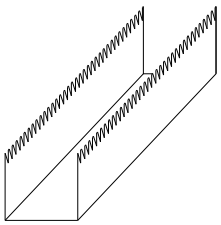

Fig 5. Water distribution groove

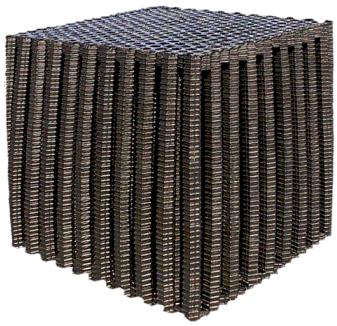

Fig 6. The lower tier is made of regular packing

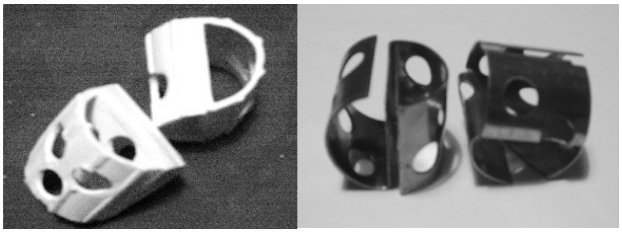

Fig 7. Nozzle type N3C and GIAP-N3

To reduce the removal of condensed moisture provided catch drops device 10, see Fig8.

Fig 8. Catch drops device

The variant used as a device catch drops thin layer of the nozzle. Hydraulic characteristics of the nozzle GIAP-N3 80 mm is shown in Fig9 as the dependence of pressure loss – ΔP, from the velocity of the gas in the apparatus.

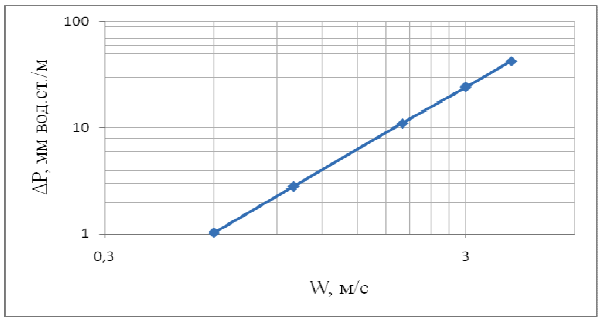

Fig 9. Hydraulic characteristics of the nozzle GIAP-H3 80 mm

The operating principle of the proposed apparatus is as follows. The flue gases are fed into the machine through the air intake box, pass through a layer of packing irrigated neutralizing soda solution, which is fed through the distribution system in the form of spraying nozzles. When passing through a layer of packing smoke-filled air is cleaned of contaminants and dust, further cooled. Next, the cleaned air passes through a demister to separate minor drops and flows through special channels in air vents facilities (kindergartens, hospitals, etc.).

Of these modules as separate elements can be assembled unit to the desired performance of cleaned gas. At the same modules can be implemented as a circular or polygonal cross-section.

The proposed device can solve the problem of cleaning large quantities of air from the smoke in extreme emergencies.

Possible solutions proposed device layout shown in Fig10 and Fig11.

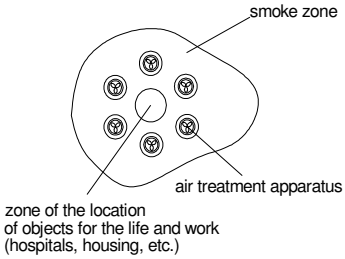

Fig 10. I variant

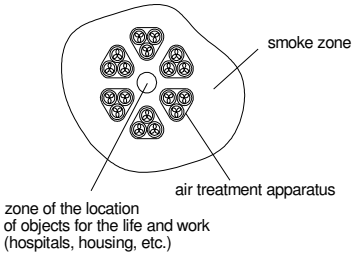

Fig 11. II variant

5. Conclusions

We propose a new design of air cleaning apparatus for a modular type high performance cleaning air, whose body is made of inflatable elements. Discussed various options for layout solutions allowing for the desired performance of cleaned gas.

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