NEW STRUCTURE OF CALCINER'S FIRE CHAMBER

Tojiev R.Zh.[1], Sadullaev H.M.[2], Soliev O.Kh.[3], Muminov H.N.[4] (Republic of Uzbekistan)
Email: Tojiev556@scientifictext.ru

[1]Tojiev Rasuljon Zhumabaevich – Professor;
[2]Sadullaev Hamidullo Mansurovich – Teacher;
[3]Soliev Oybek Khursanovich – Student;
[4]Muminov Husniddin Nuriddinovich – Student,
DEPARTMENT OF TECHNOLOGICAL MACHINES AND EQUIPMENT
FERGANA POLYTECHNIC INSTITUTE,
FERGANA, REPUBLIC OF UZBEKISTAN

Abstract: *the influencing parameters affecting to the parameters of lime burning in a calciner are - the type of fuel, the method of combustion, the speed of the coolant, filling the cross-section of the channel, the suction and pushing in of air, the speed of mass transfer processes. The main parameters of the matter: the speed of the coolant and the full filling of the cross section of the calciner body. Now the burning rate and the length of the flame of all types of hydrocarbon fuels (liquid, gaseous and solid) are reached to several meters per second.*
In order to increase the rate of burning and the length of the flame, other types of burning, we found out that in nature there are other types of burning like explosive detonation. Due to artificial turbulence in the detonation generator, the rate of ignition of coal dust increases several times.
In the article, by analyzing the velocity of the coolant and the parameters of heat and mass transfer processes in the calciner, calciner that hasbeen modernized using a heat generator.
The proposed design of a clаciner with an integrated detonation generator is explosively combustible with a mixture of coal dust and air. As coal dust, waste from cheap and widespread reserves of the local coal industry is used. In this case, the increase in the rate of ignition of coal dust in a detonation generator is justified, as a result, the contact area of fire with limestone and the productivity of the shaft furnace increase.
Keywords: *coal dust, heat generator, turbulizer, fire zone, heat engine, unit, fire suppressor, shock wave, burning rate, detonation generator.*

НОВАЯ КОНСТРУКЦИЯ КОТЛА ИЗВЕСТКООБЖИГАТЕЛЬНОЙ ШАХТНОЙ ПЕЧИ

Тожиев Р.Ж.[1], Садуллаев Х.М.[2], Солиев О.Х.[3], Муминов Х.Н.[4] (Республика Узбекистан)

[1]Тожиев Расулжон Жумабоевич - профессор;
[2]Садуллаев Хамидулло Мансурович - преподаватель;
[3]Солиев Ойбек Хурсанович - студент;
[4]Муминов Хусниддин Нуриддинович – студент,
кафедра технологических машин и оборудования,
Ферганский политехнический институт,
г. Фергана, Республика Узбекистан

Аннотация: *воздействующими параметрами, влияющими на параметры обжига извести в шахтной печи, являются – вид топлива, способ горения, скорость движения теплоносителя, заполнение поперечного сечения канала, всасывание и вталкивание воздуха, скорость процессов массообмена. Основными параметрами среды для них являются: скорость движения теплоносителя и полное заполнение поперечного сечения корпуса печи. Сейчас скорость горения и длина пламени всех видов углеводородного топлива (жидкого, газообразного и твердого) доходит до нескольких метров в секунду.*
Анализируя, с целью увеличения скорости горения и длины пламени, другие виды горения, выяснили что в природе существуют другие виды горения как взрывная детонация. В детонационном генераторе за счёт исскуственной турбулизации скорость возгорания угольной пыли возрастает в несколько раз.
В статье за счет анализа скорости теплоносителя и параметров тепло- и массообменных процессов в шахтной печи модернизирована топка печи с использованием теплового генератора.
Предлагаемая конструкция шахтной печи со встроенным детонационным генератором взрывно-возгорающим со смесью угольной пыли и воздуха. В качестве угольной пыли используются отходы дешевого и распространенного в большом количестве запаса местной угольной промышленности. В этом случае обосновано увеличение в десятки раз скорости возгорания угольной пыли в детонационном генераторе, вследствие этого увеличивается площадь контакта огня с известняком и производительность шахтной печи.

Ключевые слова: *угольная пыль, тепловой генератор, турбулизатор, зона возгорания, тепловой двигатель, агрегат, огненоситель, ударная волна, скорость горения, детонационный генератор.*

Lime products are used widely in different sphere of manufacturing, such as in metallurgy, chemical, building materials, food industry and in many other industries. Lime is used as raw materials in producing of nonferrous metal in metallurgy, silica-based materials and dry solution of building materials in building industry.

Producing lime consisted of several sequence technological processes:

- recovery of limestone;
- grinding and grading of raw materials;
- burning raw materials and cooling finished product;
- save in the limestone storage and transporting for public using.

Process demanding of more expenditure from the above mentioned technological processes is burning. So, researchers do main effort for enhancing of burning process, concerning about local resources of fuel in choosing type of fuel material, heat of combustion, influence of burning process to environment and also researchers concentrate significantly economic indicators of enhanced process.

It is known that, producing of lime products is accomplished in calciner. Nowadays gas is used as fuel in lime manufacturing factories. Requirements large quantity of gas in burning limestone, saving the gas and instead of gas fuel, there is fuel that named coal dust which is given more heat in burning process and also inexpensive cost make before us put the actual task in usage of coal dust.

More over, in this research making little dimension machine, by using modern calciner producing of lime by little manufacturing plants, create a lot more little manufacturing plants and locating that plants clothe to customers are todays demand.

There are lots of factors that influence producing lime, such as fuel type, method of burning, speed of heat-transfer agent, filling tube’s lateral surface and aspiration hole air and emitting it, mass transfer. The role of heat-transfer agent speed is significant. In todays technologies burning speed of hydrocarbons with air is consisted of meters per second.

Therefore, in order to save lime preparation time and increase efficiency at the furnace scale, a study was conducted to identify and analyze other types of combustion in order to increase the combustion rate of the mixture and prolong the flame of combustion. Analysis has shown that burning in nature is also known as detonation or an explosion, which is used when burning in internal combustion engines, heat exchangers. Part of the heat generated by the explosion is pumped into the coldest part of the fuel and oxidant in the form of light energy. The mixture begins to heat up and, as close to the combustion zone, it becomes so hot that it burns [1].

In some cases it is more convenient to transfer the combustion mixture to the fire chamber and direct it to the combustion zone through a vacuum filled with a combustible compound. However, the mechanism of heat transfer in the combustion zone of the main mechanism of combustion of the mixture remains. Examples of such combustion are examples of the combustion of a gasoline-air mixture on internal combustion engines in the space at the piston, when a diffused electric spark propagates throughout the entire connection.

In thermal technical devices the heat flow in the artificial combustion zone is directed to heat the new fuel mixture. Increasing heat during installation increases the amount of fuel burned. This is usually caused by the intervention of a hot product in the combustion zone (this phenomenon is called turbulence). The same phenomenon is used when the combustion chamber is burned in a combustion chamber. The combustion of coal is designed in such a way that the aerodynamic combustion chamber can be sprayed with a high injection rate into the calculated combustion chamber.

When burned with a mixture of coal dust, this rate of combustion can increase tenfold per second [2].

How to achieve this? The tube is filled with coal dust and air mixture. The amount of oxygen in the air should be able to absorb coal dust. The ratio of fuel and air is called the stemsometric ratio.

Suppose we burned a mixture with a strong electric torque at a sufficiently high speed on the "closed" side of the pipe. The power of the spark can be chosen so that it suddenly burns out. As a result of the explosion, the compound is heated to a temperature of about 15,000 °C. Naturally, the mixture is flammable and burns for a short time, while the temperature of the combustion products is t = 20,000 °C and the pressure is P = 17 atm. waveform and open end of tube speed D = 1800 m/s.

This theory of speed is called the detonation velocity and is denoted by the letter “D”. When the damaged waves reach the open area of the pipe, it burns the entire mixture in the pipe and increases the pressure to 17 atm, the combustion products reach 800 m / s, the temperature $t_n = 1900^0$C and the thinning zone P = 35 atm. The time when the whole mixture burns. L / D (where L is the length of the pipe, meter, D is the wave velocity, m/s). If the length of the pipe is 1 meter, the length is 1/1800 s, and if it is 3 meters, the time is 3/1800 = 1/600 s. As we have seen, the burner will work instantly, and the tube will have great potential (pressure of the combustion product), kinetic (energy 800 m/s of the combustion product), energy and heat (hot combustion products). We are confident that this explosion will not generate an explosive force, and the usual water pipe may also be under pressure. The power of each explosion is controlled by the amount of content of the tube. Of course, it can be used to perform various tasks.

Using the above-mentioned methods, the furnace of the furnace was improved and combined with the heat generator based on the speed of movement of the heat carrier, temperature and metabolism and parameters of the furnaces.

The explosive heat generating heat generator increases the speed of the carrier and speeds up the process of lime preparation.

The proposed aggregate structure is composed of the compressor 1, which supplies the compressed air cylinder liner 2 to the mixer 4, which mixes the coal powder itself with the pipe 3. As a result of mixing the hot fuel is pumped through pipe 5 at high pressure to the detonator generator 6. At high pressure, the flammable fuel is sparked with the sparking device 7, which will eventually explode. The flaming fire accelerates through the pipe 9 through the pipe 9 and enters the cylindrical chamber of the fire furnace chimney with a few meters to the tube through 11, and stops in the oven cavity for a long time in the form of asleep by specially prepared devices. High pressure air flows through the umbilicus trajectory, then goes up into the cooking zone and collides with limestone, giving it its own heat, and leaving the rest to the limestone hole in the upper drying zone. In the octopus chamber, the combustion gases emitted through the cooking zone without being burnt completely.

It is assumed that air and fuel are ideally interconnected when calculating the theoretical required amount of air required for combustion in mantle furnaces, and that each particle in oxygen combines with combustible elements [3]. However, in practice, the calculated amount of air is not enough to completely burn the fuel. Not all oxygen can ignite burning with combustible elements in the fireplace. Some of them do not react to combustion and, together with flue gases, get into a lime cooler free of charge. For complete combustion of the fuel, it is necessary to give more air than calculated.

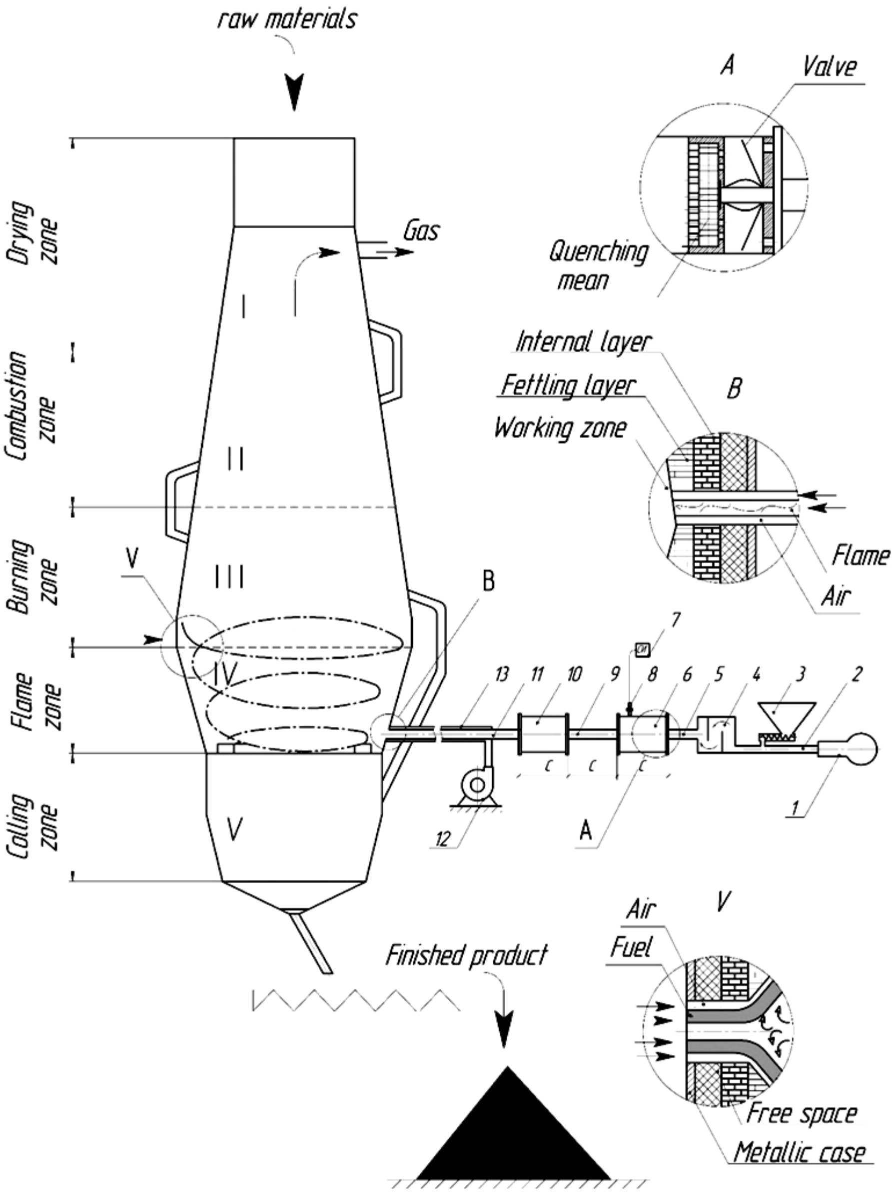

Fig. 1. Scheme of the calciner equipped with heat generator

The amount of oxygen required to burn the element of combustion of the fuel is determined by the reaction of combustion.

For example, for carbon;

$$1\text{mol C}+1\text{mol } O_2=1\text{mol } CO_2$$
$$12\text{kg} \quad 32\text{kg} \quad 44\text{kg}$$

In other words, 12 kg of carbon dioxide requires 32 kg of oxygen and 32 kg of carbon dioxide per kilogram = 2.67 kg of oxygen.

For hydrogen (H_2):

$$1\text{mol } H_2+0{,}5\text{mol } O_2=1\text{mol } H_2O$$
$$2\text{ kg} \quad 16\text{ kg} \quad 18\text{ kg}$$

That is, oxygen consumption of 2 kg of hydrogen should be 16 kg / 2 kg = 8 kg of oxygen, 1 kg of hydrogen combustion.

For sulphur (S):

$$1\text{mol S}+1\text{mol } O_2=1\text{ mol } SO_2$$
$$32\text{ kg} \quad 32\text{ kg} \quad 64\text{ kg}$$

That is, one kilogram of oxygen must be consumed in burning of 1 kilogram sulphur;

Due to the oxygen content in the working fluid, we leave the mass of this oxygen divided by the need to burn:

G_{02}=$\left[\left(\frac{\mu_{02}}{\mu_c}\right)\left(\frac{C^P}{100}\right)+\left(\frac{\mu_{02}}{\mu_s}\right)\cdot\left(\frac{S^p}{100}\right)+\left(\frac{\mu_{02}}{2\mu_{н2}}\right)\left(\frac{H^p}{100}\right)\right]-\frac{O^p}{100}$

Considering the oxygen content in the atmosphere of 21%, theoretically we calculate the amount of air required for burning 1 kg of working fuel, according to the following formula:

$$V_t=\left(\frac{G_{02}}{P_{02}}+\frac{100}{21}\right)$$

$$V_t=\left[\left(\frac{100}{21}\right)\left(\frac{1}{100}\right)\left(\frac{\mu_{02}}{P_{02}}\right)\right]\left[\left(\frac{C^p}{\mu_c}\right)+\left(\frac{S^p}{\mu_s}\right)+\left(\frac{H^p}{2\mu_{H2}}\right)-\left(\frac{O^p}{\mu_{02}}\right)\right]$$

Similar products of combustion are found in 1 kg of fuel combustion. However, experimental calculations use experimental formulas.

К=1,01·(Q^P н/1000)+0,5 К=0,89·(Q^P н/1000)+1,65

Under actual conditions, the combustible mass is required for oxidation, and not for oxidation; oxygen does not enter into chemical reactions due to exposure to air and fuel. The required excess air is determined by the ratio between the actual air vomiting B_0 and the theoretically calculated air velocity for combustion of 1 kg of fuel. This relationship is called the excess air coefficient α. The size depends on the type of fuel, the conditions in which the process takes place, the method of combustion and the furnace design. In the calculations, the value of a is chosen on the basis of the corresponding experimental data. The smaller the burner will burn, and the unit’s coefficient of efficiency will decrease significantly.

For gaseous fuel α = 1,2–1,25; For solid rocks in our case, α = 1,5-3,5

In addition, for each real case, the values of a are different. These values can be obtained from electrical engineering [5].

The proposed furnace unit is relatively inexpensive and contains large local stocks of raw materials covering the inner surface of the furnace, formed during combustion as a result of combustion and combustion in a fuel heat generator generated several times a couple times per second. In this case, the contact surface of limestone with fire increases, and production efficiency increases. In addition, the mantle chamber is divided into zones, and the hot flame enters each zone with sequential heating and continues its way and heats the lime in the drying zone to 700 ÷ 9000 ° C. The quality of lime products in a mixture of coal and air mixtures improves and the color changes that is achieved due to the fact that the furnace chamber receives more than theoretically calculated, that is, from 1,5 to 3,5 volumes of air.

The possibility of complete mechanization and automation of the combustion processes in the mill boilers is relatively simple.

From this method can be used in small and large calciner’s chamber.

References / Список литературы

1. *Тожиев Р.Ж.* Механико–технологические решения бесконтактного воздействия на почву и растения с разработкой газодетонационных агрегатов для высокоэффективного возделывания хлопчатника.Дисс. доктора технических наук. Фергана, 1993.
2. *Тожиев Р.Ж., Садуллаев Х.М., Исомиддинов А.С.* Детонацияга асосланган зарбли тўлқин берадиган генератор қурилмасини халқ хўжалигининг айрим соҳаларига қўллаш ва синаб кўриш. Фар ИТЖ, 2016 № 4. (21-26 б).
3. *Монастырев А.В.* Производство извести. М. “Стройиздат”, 1972.
4. *Табунщиков Н.П.* Производство извести. М. “Химия”, 1974.
5. *Перегудов В.В.* Теплотехника и теплотехническое оборудование М. “Стройиздат”, 1990.