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Processing of Clinker Incinerator Dust

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Annotation: Physical and chemical substantiation and development of effective technologies for processing dust klinkeroobzhigatelnyh furnaces to produce liquid and granular nitrogen-calcium fertilizer with the establishment of optimal production parameters.

Keywords: cement plants, dust, clinker furnaces, phosphorite

The Republic of Uzbekistan has a well-developed construction industry. When cement is obtained, clinker incinerator dust is formed as a waste, which is captured by electro filters. The peculiarities of the chemical composition of the dust of clinker furnaces previously did not allow it to be completely returned back to the production cycle. The main amount of dust from clinker furnaces was sent to dumps and for many years several million tons accumulated in special designated storage areas.

The dust composition of clinker-firing furnaces of electro filters strongly depends on the type of processed raw materials and technological parameters of the cement clinker firing process. The average chemical composition of clinker kiln dust on average in the Republic of Uzbekistan (Kuvasai, Akhangaran and Bekabad cement plants) (mass. %): PPP - 22.0 - 27.6; SiO_2 - 10.0 - 116.6; Al_2O_3 - 4.3 - 8.7; Fe_2O_3 -1.6 - 4.7; CaO - 40.0 - 55.0; MgO - 0.6 - 3.5; SO_3 - 0.3 - 1.4; Na_2O - 1.5 -3.9; K_2O - 1.0 - 7.4. However, when the technological parameters of the process change, the chemical composition can change quite a lot. In the dust of clinker furnaces, there are compounds that are easily soluble in water, which can be leached by water, polluting aboveground and underground waters. In addition, the dumps occupy a large number of fertile areas.

Earlier, for many years (more than 35 years), more than several hundred thousand tons of clinker kiln dust were formed annually at the cement plants of the Republic of Uzbekistan, containing valuable macro- and microelements in its composition, which agriculture urgently needs, and which were thrown into the dump.

At the moment, the main amount of dust generated by clinker furnaces in the Republic of Uzbekistan is used in the cement industry itself, i.e. cement plants operate using waste-free technology. However, the previously accumulated, huge amount of dust from clinker furnaces is not used due to the lack of acceptable technology. Meanwhile, environmental protection is one of the key points of the country's economic development. After all, in addition to a developed economy, it is also necessary to leave clean air, water and land to descendants [1].

The dust of clinker furnaces contains on average 2-4% potassium (in terms of K_2O) and up to 55% calcium (in terms of CaO). Potassium and calcium occupy the 3rd and 5th place in importance for plants. However, in the dust of clinker furnaces, they are in an insoluble and, accordingly, indigestible form for plants. The best way to process the dust of clinker furnaces is its nitric acid decomposition to obtain complex and complex fertilizers. Moreover, these fertilizers are the best for use on saline soils [2].

The declared demand of the Republic for calcium nitrate is 250-300 thousand tons per year. And there is no need to talk about the Republic's need for potash fertilizers [3]. Although there are potash salt reserves in the Republic (the Tyubegatan deposit) and there is an operating plant for the production of potassium chloride - the Dehkanabad potash plant, the dust of clinker furnaces can also become a source of potash salts and a source of trace elements. There is no production of the latter in the Republic, which are so necessary for agriculture, and which are currently being purchased from abroad.

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During the production of cement clinker, the dust of clinker-burning furnaces is formed as a waste, which is very toxic and poisons everything around.

In [4], a quantitative chemical analysis of all water supply sources in areas with a developed cement industry and in two relatively clean areas was carried out using atomic emission spectrometry. In the city of Volsk, Saratov region, in drinking water, in comparison with the MPC according to the SanPiN and WHO, contamination with chemical elements of the 1st and 2nd hazard classes - lead and chromium - was detected. In comparison with the chemical composition of drinking water from water supply sources in relatively clean regions, in residential areas, in cities of the cement industry, a significant excess of chemical elements of the 1st, 2nd, 3rd and 4th hazard classes was revealed. It is concluded that industrial enterprises for the production of cement are a source of water pollution.

This state of affairs naturally affects the health of the population, for example, the articles [4] analyze the trace element composition of hair and nails, as well as urine in 37 children aged 1 to 18 years living in a region with a cement industry, and in 21 children from conditionally clean regions. In the quantitative chemical analysis of hair and nails in children of the main group, in comparison with the control group, there is an imbalance of trace elements, excess of aluminum, iron, calcium, cobalt, cadmium, lead, arsenic, strontium, chromium, barium, molybdenum, titanium and zinc in the nails. There is an accumulation of cadmium, zinc, arsenic, antimony, chromium, cobalt, molybdenum, copper, vanadium, magnesium, barium, boron, bismuth in the hair. And this leads in turn to multiple diseases [5].

The dust of clinker furnaces is also a source of radioactive elements. The dispersed and chemical composition of clinker-burning furnace dust has been studied in the works. The distribution of heavy metals by fractions of dust particles is analyzed, the main sources of dust enrichment with heavy metals are established. The presence of radionuclides in the dust of clinker furnaces is shown.

In this regard, the use of clinker kiln dust as a fertilizer or soil ameliorant [6] is somewhat ill-considered.

It is also doubtful whether the use of clinker-burning furnace dust in agriculture is used to protect plants from pests. In the patent, as a means of protecting spring rape from pests, cement plant dust or lime fluff is used at a consumption rate of 1 ton per 1 hectare of crops.

And the paper shows that gas-cleaning dust from cyclones of the Zykovsky (ZKZ) and Achinsk (AKZ) expanded clay plants of the Krasnoyarsk Territory, as well as gas-cleaning dust from electric filters of the Krasnoyarsk Cement Plant (KTZ) are good adsorbents and can be used as preservatives-dusting agents to preserve potatoes in winter, which is also protected by patents of the Russian Federation.

The use of clinker-burning furnace dust for environmental purposes should be considered more promising. The invention relates to ecology, more specifically, to the treatment of soil contaminated with petroleum substances. The method involves applying clinker-burning furnace dust to the contaminated surface, captured by electrofilters from the exhaust gases of rotating furnaces of cement plants, with a moisture content of no more than 2%, with a layer of 1-5 cm and mixing with a soil layer of 5-10 cm.

The invention is intended for the destruction of pathogenic microorganisms in waste. The waste is mixed with the dust of clinker furnaces, settled, kept at pH 12 for at least 2 hours when the temperature of the mixture rises to a predetermined level, in a closed chamber, for a predetermined period of time. The device includes a sludge mixing chamber and a mixing medium. Heating elements provide additional heat supply to the sludge. The set pH level of the sediment is regulated by pH measuring devices.

The method provides a reduction in the level of pathogenic microorganisms in waste, in accordance with existing standards, while increasing the efficiency of the process[6].

There are various liquid fertilizers, both single and complex. In the field of production of liquid complex fertilizers (containing nitrogen, phosphorus and

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potassium), numerous studies have been carried out, including from extraction phosphoric acid based on phosphorites of Central Kyzylkums. Of liquid nitrogen fertilizers, only solutions of CAS – urea and ammonium nitrate have been well studied.

There are also a number of studies in the field of obtaining liquid one-sided nitrogen fertilizers: ammonia, ammonia water, ammoniacates and others. When certain amounts of ammonium nitrate or calcium nitrate, carbamide and other nitrogen-containing substances are dissolved together or separately in ammonia water, solutions called ammoniacates are obtained.

Solid ammoniacates are formed by the interaction of some solid salts with gaseous or liquid ammonia and are complex compounds of a crystalline structure.

The ammoniacates obtained in the form of solutions are light liquids (yellowish coloration is also allowed), the density of which depends on their composition and ranges from 0,9 – 1,25 g/cm^3. The vapor pressure above the ammonia is significantly lower than the vapor pressure above liquid ammonia. The composition of ammonium nitrate-based ammoniacates corresponds to the formula NH_4NO_3 – $nNH_3 \cdot mH_2O$. Ammoniacates based on calcium and ammonium nitrate correspond to the formula $Ca(NO_3)_2 * NH_4NO_3 – nNH_3 \cdot mH_2O$. carbonammiacates are also used – mixtures of aqueous solutions of ammonium carbonate, ammonia, carbamide or ammonium nitrate.

The tests carried out and the data obtained indicate that nitrogen-calcium fertilizers from the dust of clinker furnaces (ZHAKU-2 and GAKU-2) have a positive effect on the accumulation of full-fledged boxes, which leads to an increase in the yield of raw cotton by 6,60 and 8,53% compared with the control variant (ammonium nitrate). An additional increase in yield is due to the presence of trace elements of zinc, molybdenum.

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