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SMART MICROCLIMATE CONTROL SYSTEM BASED ON AN ADAPTIVE FOG GENERATOR WITH SOLAR POWER SUPPLY FOR MINING ENTERPRISES

Abstract: In conditions of extremely high temperatures and dustiness at industrial sites—especially in the mining and construction industries—the need for effective air cooling and dust suppression systems is increasing. Reducing the formation of natural and man-made dust is a serious issue for mining enterprises. Fine particulate dust in suspension is generated during the transportation, handling, storage, and stockpiling of mined material. It is well known that dust provokes many illnesses commonly categorized as occupational diseases.

In addition, dust generation leads to increased equipment operating costs and presents challenges in complying with the environmental legislation of the Republic of Uzbekistan.

Keywords: fine water misting, fog generator, technology, mining industry, dustiness, technical water, renewable natural resources.

УМНАЯ СИСТЕМА МИКРОКЛИМАТ-КОНТРОЛЯ НА ОСНОВЕ АДАПТИВНОГО ТУМАНОГЕНЕРАТОРА С СОЛНЕЧНЫМ ПИТАНИЕМ ДЛЯ ГОРНОДОБЫВАЮЩИХ ПРЕДПРИЯТИЙ

Аннотация: В условиях экстремально высоких температур и запыленности производственных площадок, особенно в горнодобывающей и строительной промышленности, возрастает необходимость в эффективных системах охлаждения воздуха и подавления пыли. Снижение образования пыли природного и техногенного происхождения является серьёзной проблемой в горно-промышленных предприятиях. Мелкодисперсная пыль во взвешенном состоянии появляется при транспортировке, перегрузке, хранении, складировании горной массы. Всем известно, что именно пыль провоцирует многие заболевания, которые обычно характеризуют как «профессиональные».

Кроме того, пыление — это увеличение затрат предприятия на эксплуатацию оборудования, а также проблемы с соблюдением экологического законодательства Республики Узбекистан.

Ключевые слова: мелкодисперсного распыления воды, туманогенератор, технология, горнодобывающая промышленность, запылённость, техническая вода, возобновляемые природные ресурсы.

QUYOSH ENERGIYASIDA ISHLOVCHI MOSLANUVCHAN TUMAN HOSIL QILUVCHI GENERATOR ASOSIDAGI KON SANOATI UCHUN MO‘LJALLANGAN AQLLI MIKROIQLIM NAZORATI TIZIMI

Annotatsiya: Ishlab chiqarish maydonlarida, ayniqsa konchilik va qurilish sanoatida, o'ta yuqori harorat va changlanish sharoitida havo sovitish va changni bostirish bo'yicha samarali tizimlarga ehtiyoj ortib bormoqda. Tabiiy va texnogen manbali chang hosil bo'lishini kamaytirish kon sanoat korxonalarida dolzarb muammolardan biridir. Mayda dispers chang ko'p hollarda ruda massasini tashish, ortish, saqlash va omborlash jarayonlarida havoda muallaq holatda paydo bo'ladi. Hammaga ma'lumki, aynan chang ko'plab kasalliklarni keltirib chiqaradi va ularning aksariyati "kasbiy" deb ataladi.

Bundan tashqari, changlanish korxonada uskunalarni ishlatish xarajatlarining oshishiga olib keladi hamda O'zbekiston Respublikasi ekologik qonunchiligiga rioya qilishda muammolarni yuzaga keltiradi.

Kalit so'zlar: suvning mayda zarrachalarga purkalishi, tuman hosil qiluvchi generator, texnologiya, kon sanoati, changlanish, texnik suv, qayta tiklanuvchi tabiiy resurslar.

One of the modern and effective technologies is the use of fine water misting systems, also known as fog generators. This technology involves creating a fine water mist that quickly evaporates without wetting surfaces. These systems are widely used for air cooling and humidification. The technology not only helps reduce air temperature but also significantly lowers the concentration of harmful particles in the atmosphere, creating safer and more comfortable working conditions.

Fine water misting is based on supplying water under high or low pressure through special nozzles, which produce microscopic droplets with diameters ranging from 5 to 50 microns. These droplets do not wet surfaces and evaporate quickly into the air. During evaporation, thermal energy is absorbed, which helps lower air temperature. The small droplets also bind effectively to dust particles, making them heavier and causing them to settle.

The use of such technology ensures effective air temperature reduction by 5–10 °C, dust concentration reduction by 70–90%, and increases work efficiency—up to 90% or more. The use of renewable natural resources and economical consumption of technical water (from 5 to 50 liters per hour) represents a rational use of natural resources.

This new technology helps purify the air from harmful gases and dust. The main features of the technology include:

- Easy maintenance and flexible installation;
- No wetting of surfaces;
- Reduced fire hazard in dry areas;
- Improved working conditions and reduced risk of worker overheating.

The technology reduces the volume of water required for standard dust suppression by up to 10 times. When using special spray nozzles and adhering to proper solution delivery protocols, the amount of dust-suppressing solution needed for treating mined material can also be reduced.

Without dust suppressants in the water used for dust suppression, the sprayed water dries quickly on the material's surface, and dust can reappear. Dust suppressants dissolved in water penetrate the material and bind the particles together. As a result, the mass and size of particles increase,

preventing dust from becoming airborne. There is a significant difference between suppression systems with and without additives. Many dry, dusty materials are practically unaffected by plain water—some parts become excessively wet, while others remain dry and dusty. By adding wetting agents to the water and spraying this solution onto dry, dusty material, reliable and long-lasting dust suppression is achieved.

Fine water misting (fog generators) is a progressive and environmentally safe technology that effectively combats heat and dust in industrial facilities and public spaces. The use of fog generators improves sanitary and hygienic conditions, boosts labor productivity, and reduces the risks associated with high temperatures and dustiness. Considering climate change and growing demands for comfortable working environments, such systems are becoming an essential part of modern industrial infrastructure.

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