performance, such as fluidization velocity, bed material selection, and fuel properties, must be carefully optimized to maximize efficiency and minimize emissions.

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ANALYSIS OF THE THERMODYNAMIC EFFICIENCY OF SOLID FUEL COMBUSTION IN A VORTEX FURNACE

АНАЛІЗ ТЕРМОДИНАМІЧНОЇ ЕФЕКТИВНОСТІ СПАЛЮВАННЯ ТВЕРДОГО ПАЛИВА У ВИХРОВІЙ ПЕЧІ

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The thermodynamic efficiency of solid fuel combustion in vortex furnaces is a key factor in enhancing energy conversion processes and minimizing environmental impact. Vortex combustion technology is characterized by intense fuel-air mixing, which improves the combustion process by ensuring a more uniform temperature distribution and reducing unburned carbon losses. This study provides a comprehensive analysis of the thermodynamic efficiency of solid fuel combustion in vortex furnaces, examining the fundamental principles governing heat and mass transfer, combustion kinetics, and gas flow dynamics. The research focuses on the impact of key parameters, including turbulence intensity, excess air ratio, fuel particle size, and combustion chamber geometry, on the overall efficiency of the system [1].

Vortex furnaces utilize the principles of aerodynamics to create a highly turbulent swirling flow of fuel and oxidizer, which enhances mixing and increases the residence time of fuel particles within the combustion zone. This intensified mixing results in more complete combustion, leading to improved thermal efficiency and lower emissions. The primary mechanisms influencing thermodynamic efficiency in such systems include heat transfer through conduction, convection, and radiation, chemical energy conversion through oxidation reactions, and the influence of unsteady combustion phenomena [2].

One of the critical aspects of vortex combustion is the formation and stabilization of the flame within the furnace. The swirling motion of the gas flow generates centrifugal forces that create a recirculation zone, allowing for better heat retention and ensuring a stable combustion process. This reduces the formation of localized high-temperature zones, which are often responsible for increased thermal NOx emissions. Additionally, enhanced mixing minimizes the presence of unburned carbon, increasing fuel utilization efficiency [3].

A detailed analysis of heat transfer mechanisms within the vortex furnace reveals that the combination of forced convection and radiation plays a significant role in determining the overall heat absorption by furnace walls and subsequent energy conversion. The swirling flow pattern significantly increases the heat transfer coefficient, improving the rate at which thermal energy is extracted from the combustion process. The study also explores how varying the excess air ratio influences combustion efficiency. While a higher excess air ratio can lead to better oxidation of fuel particles, excessive air supply results in heat loss due to the increased mass flow of flue gases, reducing the overall thermal efficiency [4].

Another key factor in thermodynamic efficiency is the effect of fuel properties on combustion performance. Fuel moisture content, volatile matter percentage, and ash composition impact the ignition characteristics, burnout rate, and slagging tendencies in vortex furnaces. The study examines various solid fuels, including coal, biomass, and municipal waste, to assess their suitability for vortex combustion systems. High-volatile fuels tend to ignite faster and more completely, whereas high-ash fuels may introduce operational challenges related to clinker formation and heat exchanger fouling [5].

Additionally, the influence of furnace design parameters, such as burner arrangement, combustion chamber geometry, and refractory lining, is analyzed. The optimization of these parameters plays a crucial role in reducing heat losses and ensuring maximum energy utilization. Computational fluid dynamics (CFD) simulations and experimental data are employed to evaluate the effectiveness of different vortex furnace configurations in improving thermal efficiency. The integration of advanced control systems, such as real-time monitoring of combustion conditions and adaptive air supply regulation, further enhances the overall performance of vortex combustion technology.

The analysis of thermodynamic efficiency in solid fuel combustion within vortex furnaces highlights the significant advantages of this technology in improving energy utilization and reducing environmental impact. The swirling motion of gases enhances fuel-air mixing, leading to more complete combustion, lower unburned carbon losses, and improved heat transfer efficiency. The research demonstrates that optimizing key parameters such as turbulence intensity, excess air ratio, and fuel properties can significantly enhance the overall performance of vortex furnaces.

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ЕЛЕКТРОСПІКАННЯ НАНОПОРОШКІВ ДІОКСИДУ ЦИРКОНІЮ, СИНТЕЗОВАНИХ МЕТОДОМ РОЗКЛАДАННЯ ФТОРИДНИХ СОЛЕЙ

ELECTROSINTERING OF ZIRCONIUM DIOXIDE NANOPOWDERS SYNTHESIZED BY THE DECOMPOSITION OF FLUORIDE SALTS

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Поєднання особливих характеристик, таких як підвищена міцність, в'язкість руйнування, висока твердість, зносостійкість, низькі коефіцієнти тертя, а також хімічна та біологічна інертність робить діоксид цирконію (ZrO_2) виключно перспективним матеріалом для застосування у багатьох технічних сферах. Він знайшов широке застосування при створенні високовогнетривких виробів, жаростійких емалей, стійкого до високих температур скла, різноманітних керамічних виробів, керамічних пігментів, твердих електролітів, захисних термічних покриттів, каталізаторів, штучних дорогоцінних каменів, а також під час виробництва різальних інструментів та абразивних матеріалів.

В даний час діоксид цирконію стрімко поширюється на нові сфери застосування, такі як медицина, волоконна оптика та виробництво електронної кераміки. Важливо відзначити, що найбільш вражаючі значення механічної міцності та тріщиностійкості, при збереженні стійкості до корозії та зношування,