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SUSTAINABLE DEVELOPMENT IN INDUSTRY AND ENERGY: ANALYSIS OF GREEN SOLUTIONS AND CALCULATION METHODS

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Abstract

This article analyzes "green solutions" in the fields of industry and energy. It discusses both scientific and practical approaches to saving natural resources, reducing atmospheric emissions, and ensuring sustainable development on a global scale. Key areas include renewable energy sources, energy efficiency, reduction of CO_2 emissions, and resource conservation. Efficiency calculations of solar panels and industrial equipment are presented using specific formulas. Additionally, the article includes real-world examples of the power and energy consumption of electrical devices. The analysis and calculations shown here are considered essential factors in promoting energy savings and environmental sustainability.

Keywords

Green solutions, renewable energy, solar panels, energy efficiency, CO_2 emissions, power factor (cosφ), electrical equipment, energy saving, sustainable development, power formulas, industrial equipment, environmental impact, energy consumption, scientific approach.

Introduction

Globally, there is a growing effort to conserve natural resources, reduce emissions into the atmosphere, and ensure sustainable development, especially in industry and energy. Green solutions are widely applied in these sectors and are developed based on efficiency metrics and scientific methodology. This article analyzes several of the most important green solutions in the field [1; 2].

1. Green Energy Sources

Green energy refers to power derived from renewable sources such as solar, wind, water, and biomass. Solar energy can be calculated using the following formula:

$$E = A * H * \eta \qquad (1)$$

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where::

E — is the generated energy (Wh),

A — is the surface area of the solar panel (m²),

H — is the solar radiation intensity (W/m²),

η — is the panel efficiency (in %). [1; 2; 3].

Example: A 10 m² solar panel with 20% efficiency and solar radiation intensity of 1000 W/m² would generate: [3; 4].

$$E = 10 * 1000 * 0{,}2 = 2000 \text{ Вт} * \text{соат}$$

2. Energy Efficiency

Energy efficiency in industry is a key indicator of how effectively energy resources are used. It can be calculated by: [3; 4; 5].

$$\eta = \frac{P_{output}}{\mathrm{P}_{input}} * 100\% \qquad (2)$$

where::

η — is energy efficiency (%),

P_{output} — is the output energy (W),

P_{input} — is the input energy (W).

Example: If an industrial device receives 10 kW input and produces 8 kW output: [5].

$$\eta = \frac{8}{10} * 100\% = 80\% \qquad (3)$$

3. Reducing CO_2 Emissions from Coal and Gas Use

Using fossil fuels increases CO_2 emissions. The amount of emissions can be calculated as:

$$Q_{co2} = F * EF \qquad (4)$$

where:

Q_{co2} — is the CO_2 emissions (tons),

F — is fuel consumption (tons),

EF — is the emission factor (tons/ton fuel).

Example**:** Using 1 ton of coal with an emission factor of 2.5: [4; 5].

$$Q_{co2} = 1 * 2{,}5 = 2{,}5 \text{ тонна}$$

To reduce emissions, the use of renewable sources and energy-saving technologies is essential.

4. Resource Conservation in Manufacturing

Minimizing energy use in industrial processes is crucial for resource conservation. The power consumption PPP of electrical devices is calculated by:

$$P = I * U * cos\varphi \qquad (5)$$

where:

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P — is power (W),

I — is current (Amps),

U — is voltage (Volts),

$cos\varphi$ — is the power factor.

Example**:** For a device with 10 A current, 220 V voltage, and $cos\varphi$ = 0.9

$$P = 10 * 220 * 0{,}9 = 1980 \text{ Вт.}$$

According to the calculation result in the example above, the electrical device consumes 1980 watts of power. This calculation allows for an accurate assessment of the device's power and energy consumption. Taking the power factor (cosφ = 0.9) into account contributes to the accuracy and efficiency of the results. Such an approach enables precise evaluation of energy consumption in production processes. Understanding the operational characteristics of the device forms the basis for developing energy-saving strategies. Devices with a power rating of 1980 W consume a significant amount of energy in industrial operations. Therefore, accurately calculating the power of each piece of equipment can help reduce overall consumption. Precise measurement of energy consumption is crucial for the rational management of resources. This kind of approach lays the groundwork for implementing energy-efficient technologies. Furthermore, it contributes to reducing production costs and minimizing environmental impact. Through such calculations, the impact of each device can be evaluated, and the overall system efficiency can be improved. This ensures sustainable and efficient operation at the enterprise level. Thus, the result of 1980 W is not just a number—it serves as a fundamental basis for making important decisions in energy management.

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