Discussion on Pre Heating Kiln

The discussion primarily focuses on the advantages and challenges of using preheated rotary kilns in coal-based DRI (Direct Reduced Iron) production. The key points discussed include

1. Preheating Kiln Advantages: Improved Production: Preheating technology has shown to increase production rates, with 50 TPD kilns producing up to 75 tons/day, compared to 55 tons in conventional kilns. Better Grade Consistency: Preheating leads to more consistent ore grades, especially for lower-grade ores, improving iron content by about 2% compared to normal kilns. Coal Savings: The preheater system offers around a 5% coal savings, which is significant, especially when using low-grade ores.

2. Challenges and Considerations: Back Pressure: Initially, some plants faced issues with back pressure at the feed end, which could affect kiln life. However, modifications to hood design and increasing the preheater diameter helped resolve these issues. Kiln Size and Power Generation: Preheating technology is more suitable for smaller kilns (50 TPD). In larger kilns (100 TPD and above), power generation becomes less feasible, and the technology may not be as effective. Kiln Design: The ideal kiln length-to-diameter ratio (L/D) must be considered to avoid issues like back pressure. Reducing the preheater length and increasing the diameter helped optimize the performance of the smaller kilns.

3. Energy Generation: In smaller kilns (50 TPD), there was a successful implementation of power generation from waste heat recovery boilers (WHRB), although this becomes challenging in kilns larger than 100 TPD. The discussion touched on the potential of biomass and renewable energy options like solar and wind power to help reduce CO_2 emissions in coal-based DRI production.

4. Economic Feasibility: While power generation is sacrificed in smaller preheated kilns, the cost savings from reduced coal consumption and increased production rates make it an economically viable option for many plants. The discussion suggested that smaller plants with preheating technology could still be competitive and efficient, even without the ability to generate power.

5. Next Steps: Further theoretical studies are needed to determine the optimal preheat temperature relative to kiln size. This could potentially be a research project for students. It was noted that back pressure control and kiln modifications were key to making preheating technology work successfully Overall, the preheating technology is seen as an effective solution for improving productivity, reducing coal consumption, and maintaining consistent product quality in smaller rotary kilns, though it may not be suitable for larger kilns or power generation purposes.

The discussion revolves around optimizing the production and power generation capabilities in sponge iron plants, focusing on the use of preheating technology and its integration with power plants.

Key Points:

1. Preheating in Kilns: There is a consensus that using preheaters in kilns can significantly increase production. A suggestion is made to aim for a 2x increase in production through better heat utilization. In some plants, the use of preheaters has led to up to a 3x increase in production. However, it is noted that preheaters work best with high-quality ores, like those found in Bellary, and may not be as effective in other regions with lower-quality ores.

2. Power Generation Challenges: The group discusses the viability of generating power from the kilns. It is noted that power generation is more feasible in large plants (e.g., 100 TPD) than smaller ones (e.g., 50 TPD). The economic feasibility of smaller power plants is questioned, as their capital cost is high and the operational expenses are substantial. In smaller plants, generating excess power is not always viable. Power plant costs are considered too high (₹6–6.5 crore per MW) to make smaller plants profitable. A 2 MW power plant might not be cost-effective for smaller plants (50 TPD) as the operational costs outweigh the benefits.

3. Coal and Ore Quality: The quality of coal and ore has a significant impact on power generation. Indian coal, particularly low-grade coal with higher volatile matter (VM), can lead to better power generation when used in the kilns. For example, using Indonesian coal with higher VM helps generate more power due to its higher energy content. The type of coal and ore significantly impacts the feasibility of generating power and the total yield from the plant.

4. Power Generation from Solar: One participant mentions trialing solar power generation using 185W solar panels near the kiln shell, with plans to upgrade to 540-585W panels. However, there are challenges in synchronizing solar power with grid requirements, as the efficiency of solar panels is generally about 40%, and storage solutions are not universally available. Solar power is seen as a promising but not fully reliable solution, as it is dependent on weather conditions and the availability of sunlight. A suggestion is made to test using a hot plate above the solar panels to assess heat-based power generation.

5. Economic Analysis: The economic viability of different setups is discussed, comparing the costs and benefits of a solar power plant with those of a conventional power plant. It's suggested that even though the initial cost for solar power plants is high, the return on investment could be achieved in around three years, especially with the additional benefit of carbon credits. The operational cost of power generation in smaller plants (under 50 TPD) is considered too high to be feasible for most operators, who may not have the capital to invest in power plants.

6. Future Trials and Research: Some participants plan to visit sponge iron plants in the coming days to study CO_2 generation and reduction methods. These visits aim to gather more data on the potential for reducing emissions and improving energy efficiency in the industry.