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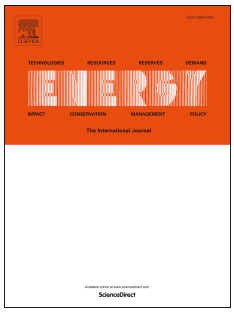

Economic evaluation of flameless phosphate rock calcination with concentrated solar power and high temperature reactors

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PII: S0360-5442(17)31498-6

DOI: 10.1016/j.energy.2017.08.123

Reference: EGY 11492

To appear in: *Energy*

Received Date: 25 January 2017

Revised Date: 28 August 2017

Accepted Date: 31 August 2017

Please cite this article as: Haneklaus N, Schröders S, Zheng Y, Allelein H-J, Economic evaluation of flameless phosphate rock calcination with concentrated solar power and high temperature reactors, *Energy* (2017), doi: 10.1016/j.energy.2017.08.123.

Economic evaluation of flameless phosphate rock calcination with concentrated solar power and high temperature reactors

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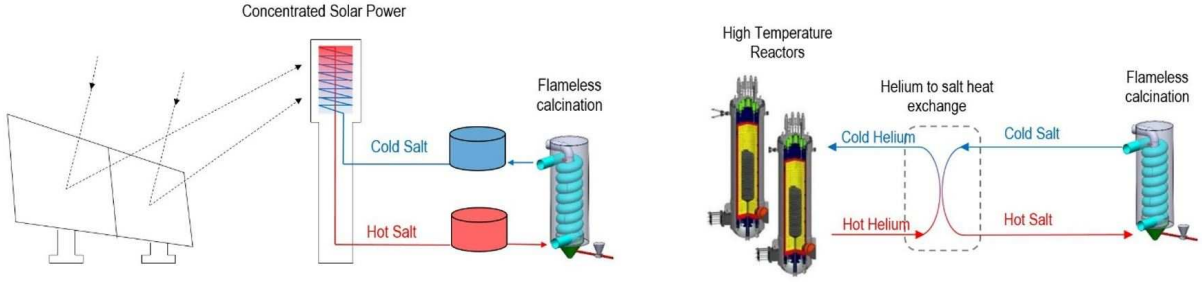
Graphical abstract:



Abstract:

Flameless calcination, where a heat transfer fluid is used to provide heat for the calcination reaction to a mineral feed material may reduce direct carbon dioxide emissions during calcination by 50%. Concentrated solar power (CSP) and high temperature reactors (HTRs) are low-carbon emitting energy sources suitable for flameless calcination. This work provides a brief economic evaluation of flameless phosphate rock calcination with CSP/HTRs as heat sources. The economic evaluation consists of cost comparisons against gas-fired kilns and economic feasibility calculations based on the net present value method. The flameless system with CSP/HTRs is currently not cost-competitive. Anticipated cost reductions and higher natural gas prices may, however, change this outcome in the future. For the flameless system to be competitive low-interest rates (5-10%) and higher natural gas prices (7.5-10 US$/mmBTU) need to be present. Although the flameless system with CSP/HTRs is presently not cost-competitive it can be economically viable given low-interest rates (≤5%) and higher end heat selling prices (≥45 US$/MWh$_{th}$).

Keywords: Flameless calcination, concentrated solar power, high temperature reactors, economic evaluation, phosphate rock