Optimal Operating Point of a MgB_2 Based Magnetic Density Separation System

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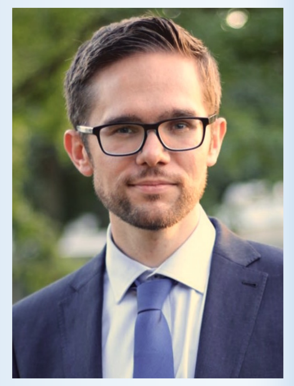
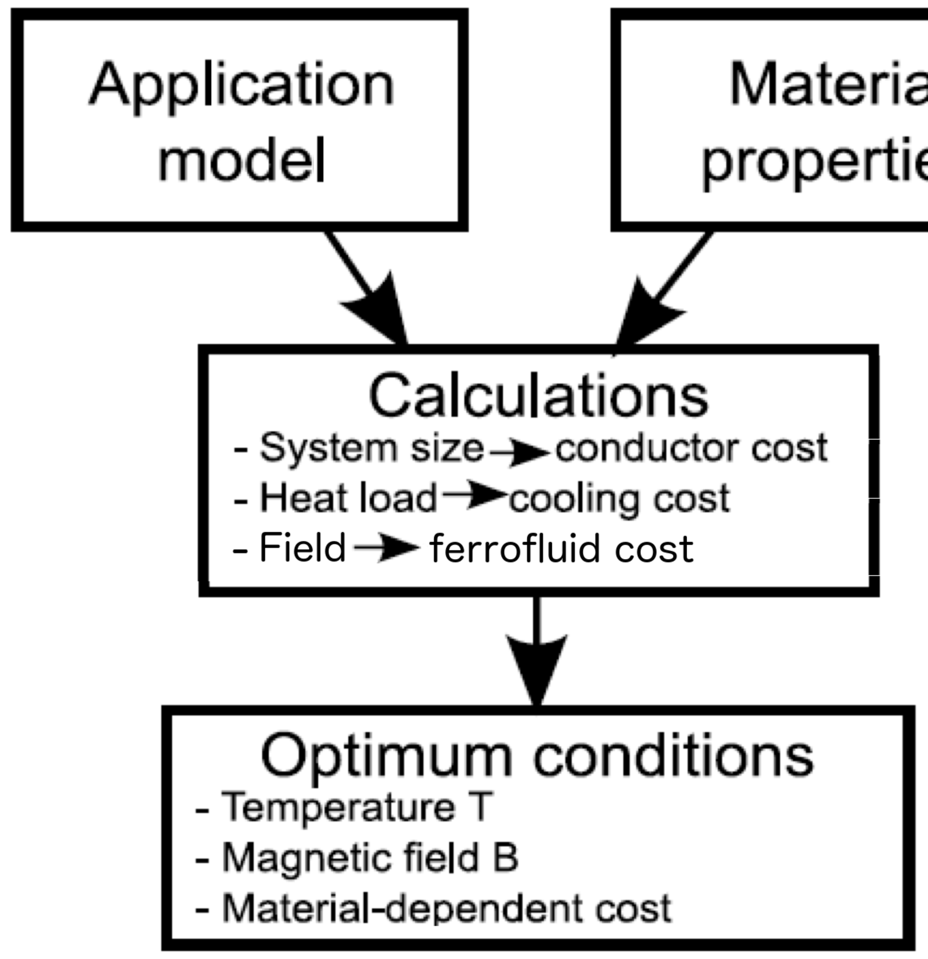


Abstract

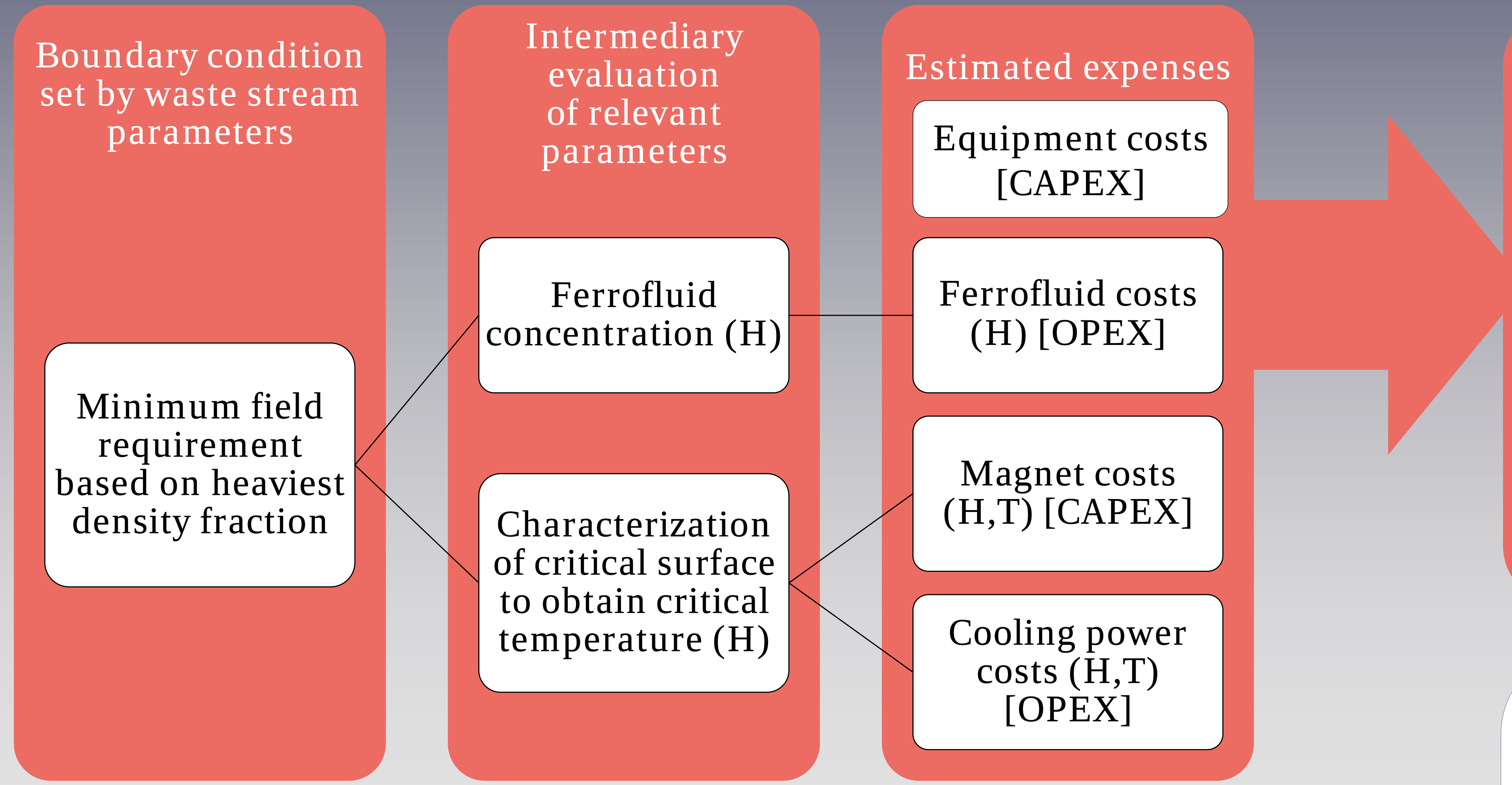
Superconducting MgB_2 wire is characterized to analyze its ***optimum operating point*** in terms of field and temperature in a magnet system designed for magnetic density separation (MDS). In order to determine the optimal configuration of field and temperature, both **application costs (OPEX) and material costs (CAPEX) are estimated**.



With its relatively high critical temperature and low cost, MgB2 is a prime candidate material to realize the MDS magnet. More information on the MDS system is presented on the poster by J.J.Kosse et al.

Benefits of implementing a MgB_2 wire

- Mg and B components are abundant
- Relatively high critical temperature
- Suitable for conduction-cooling
- Relatively low cost
- Material still developing and improving



Minimum field requirement

The minimum field required to operate the MDS system is determined by the waste stream specific parameters, such as:

- The heaviest mass density ρ_{max}
- Saturation magnetization of the ferrofluid M_s

The **minimum required field** (H) that the magnet should generate in order to lift waste particles up to the heaviest fraction is

$$H_{min} \sim (\rho_{max} - \rho_{ff})/M_s$$

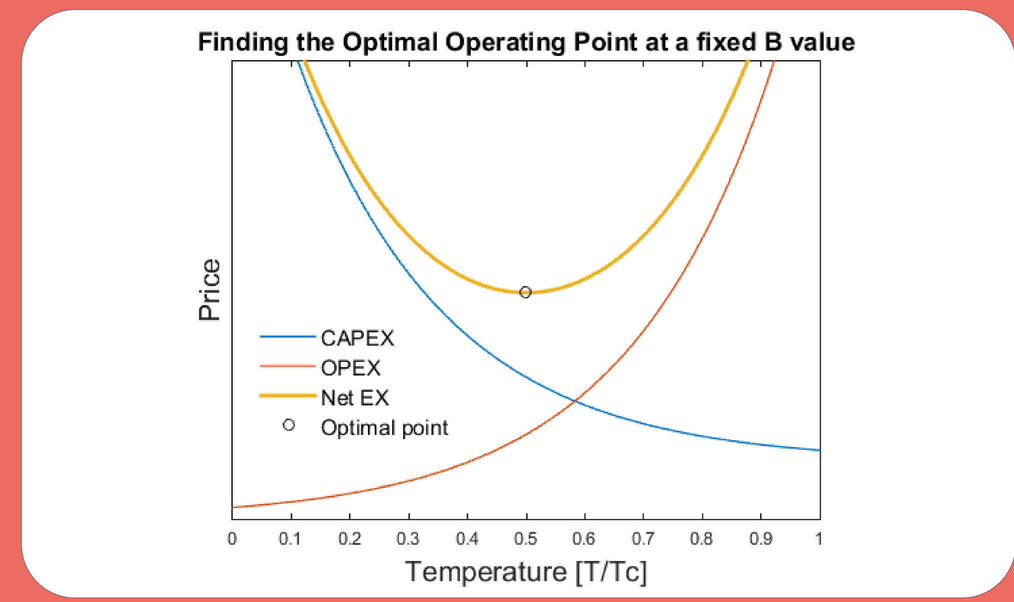
where ρ_{ff} is the density of the ferrofluid.

Characterization of MgB_2 critical surface

A MgB2 sample supplied by Columbus Superconductor SpA is characterized on its critical surface:

- Measurements are conducted over 4.2 to 30 K at a set of fields up to 10 T.
- Acquired temperature - field data allow evaluation of conductor volume and heat inleak.

Optimal Operating Point



Cost estimation

Ferrofluid

- $M_s(H)$ relates to ferrofluid concentration
- From the concentration, the ferrofluid cost is estimated $€_{ff}(H)$ (OPEX)

Magnet volume

- Obtain current sharing temperature from critical surface
- Use proposed magnet design to obtain req. MgB2 volume
- Conductor price $€_{MgB2}(H,T)$ (CAPEX)

Cooling power

- Determine required cooling power
- Penalty factor
- Life cycle + estimated avg. kWh price
- Cooling price $€_{cryo}(T)$ (OPEX)

Acknowledgements

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