

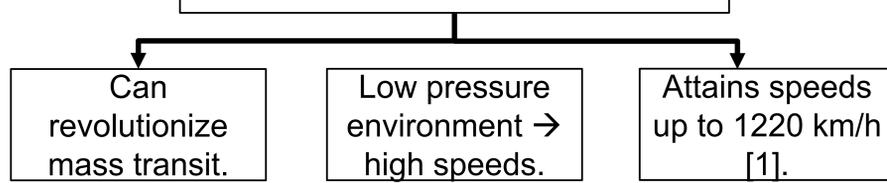
Hyperloops: The Future of Transport

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Situation

- Hyperloops are floating pods enclosed within vacuum tubes.
- Current modes of transportation need to be optimized due to transit time, environmental issues, and safety concerns.

Advantages of Hyperloops



Problems

Eddy Currents

- Motion depends on rate of change of magnetic field.
- Energy losses eventually slows down the hyperloop.

Infrastructure Costs

- Various components needed in large amounts (solar panels).

Kantrowitz Limit

- Air gets trapped in the tube and causes pressure build-up.
- Decreases the speed of the Hyperloop.

Supporting Structures

- High temperature causes expansion of structural support.
- Increasing tube thickness makes the Hyperloop heavier.

Component	Cost (million USD)	Notes
Tube Construction	650	709.2 miles of Tube
Pylon Construction	2,550	25k pylons
Tunnel Construction	600	15.2 miles of tunnel
Others	1610	
Total	5,410	

Table 1: Infrastructure costs [2]

Solutions

Use lamination in aluminum cores

- Minimizing eddy currents and energy losses [3].
- Hyperloop maintains a high speed.

Selection of a better material in solar panels

- Makes batteries more efficient.
- Battery becomes more durable.

Use compressors and alter aerodynamics of pods

- Extra thrust generated.
- Reduction of pressure at the inlet.

Construct the Hyperloop underwater

- Significant reduction of thermal expansion.
- Buoyancy forces stabilize the system underwater.

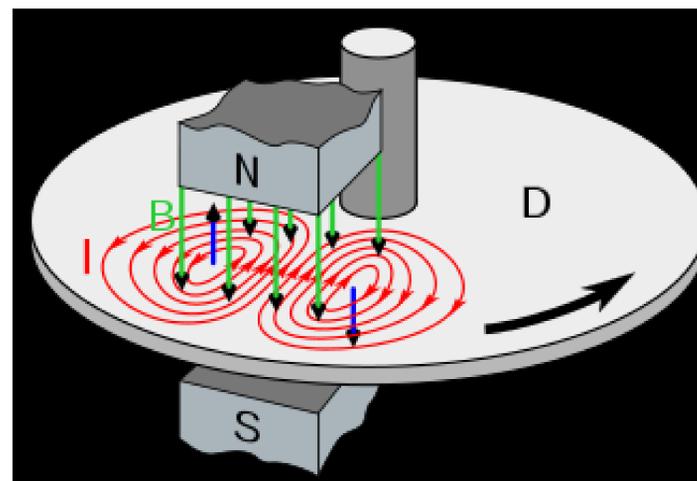


Figure 1: Eddy Currents Induced (red lines)

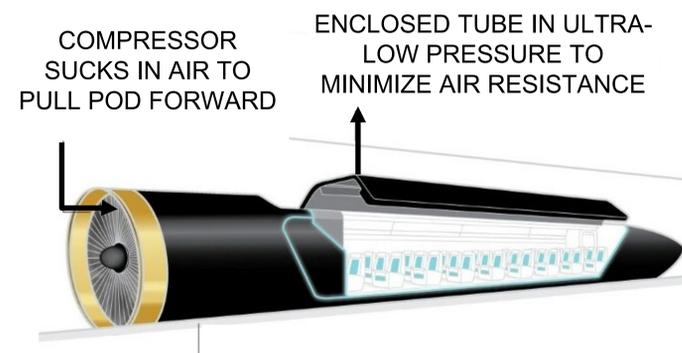


Figure 2: The Function of Compressors

Evaluation

- Inspection of the whole tube is time consuming.
- Requires lots of batteries due to limited life span.
- Continuous maintenance is required.
- Specific axial compressors are required to maintain the vacuum system.
- Power consumption of compressors are quite high -> additional cost and maintenance.
- At larger depths, the system would be unstable due to large buoyancy forces exceeding the weight of the system.

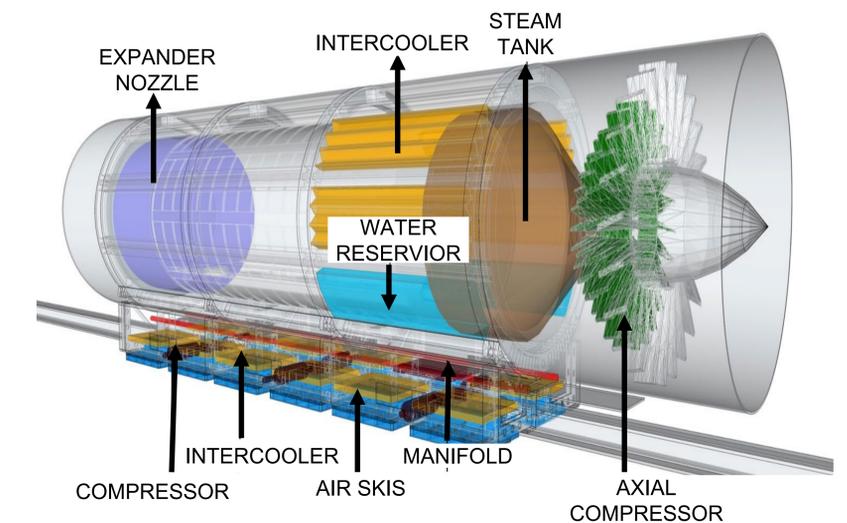


Figure 3: Axial Compressors

Recommendations

- Minimizing the area of the Hyperloop pod increases speed.
- Vacuum in the Hyperloop is necessary to gain speed.
- Thermal expansion of the system can be solved by increasing the thickness of steel.

References

- [1] S.Chapman, Electric machinery fundamentals, Tata Mcgraw-Hill Education, 2005.
- [2] J. C. Chin and J. S. Gray, "Open-source conceptual sizing models for the hyperloop passenger pod," in 56th AIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 2015.
- [3] M. Sakowski, "The Next Contender in High Speed Transport Elon Musks Hyperloop," Journal of Undergraduate Research, vol. 9, pp. 43-47, 2016.

Other references available upon request.