EM pump

A very short literature search

Target videoconference 28.1.2004

WHY?

- No moving parts in contact with target liquid
- No seals

highly reliable

Problems?

- High slip → high power consumption
- Heating of the liquid by Ohm losses
  → CRITICAL

Can we reach the desired flow rate? (1cm jet, 1l/s, 20 m/s)

Existing applications

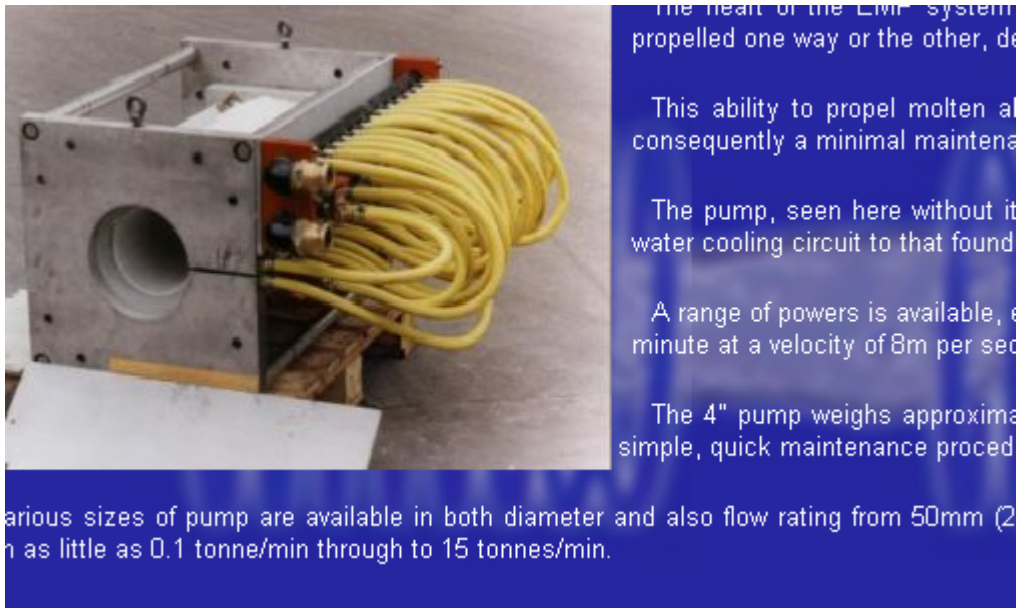
- Aluminium production
- Testing Pb-Be loops
  - MegaPie
  - ADS
  - spallation source
- Sodium circuit in nuclear facilities
- …

MegaPie

- MegaPie: Megawatt Pilot Experiment
  - Spallation source
- LiSoR: **Li**quid metal-**So**lid metal **R**eactions
  - Lead-bismuth: <0.3 l/s, <1.5 bar, <2 m/s
  - Journal of Nuclear Materials 318 (2003) 70–83
- LiSoR like facility at JAERI / KEK

Mercury Thermal Hydraulic Loop (MTHL) Became Operational in October 1999

Aluminium production



http://www.emptechnologies.com

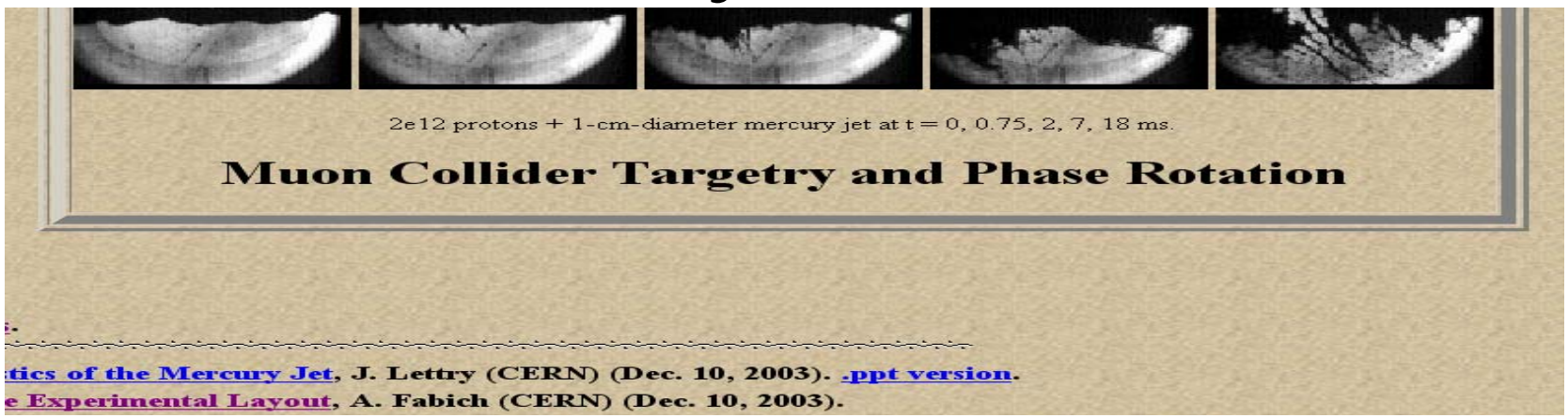
"In mass flow terms the 65kW model can move up to 10 tonnes of aluminium per minute at a velocity of 8m per second."

Literature

- I.R.Kirrilov et al., Tow dimensional model for analysis of cylindrical linear induction pump characteristics: model and numerical results, Energy Conversion management 44 (2003) 2687-2697
- http://www.fjfi.cvut.cz/con_adtt99/papers/Mo-o-b10.pdf
  - EM pump 50 % efficiency at most
- *linear induction pump, Sodium loop, 7 m3/min*
  - *H. Araseki et al. / Nuclear Engineering and Design 227 (2004) 29–50*
- *IPUL, RIGA working for ESS, LiSoR*
- *http://mhd.sal.lv/*
  - *High pressure and high flowrate induction pumps with permanent magnets , Magnetohydrodynamics **39**, No. 4, 411-418, **2003***
  - *Centrifugal pump basing on rotating permanent magnets, Magnetohydrodynamics **36**, No. 2, 157-164, **2000***
- R.Moureau, Magnetohydrodynamics, Kluwer Academic Publishers, 1990

- Pump with em coupling: http://www.linden-emb.com/Parts/pumps.htm

One always ends here



Where you find a link to:

Proposal: Shock wave simulation in liquid …

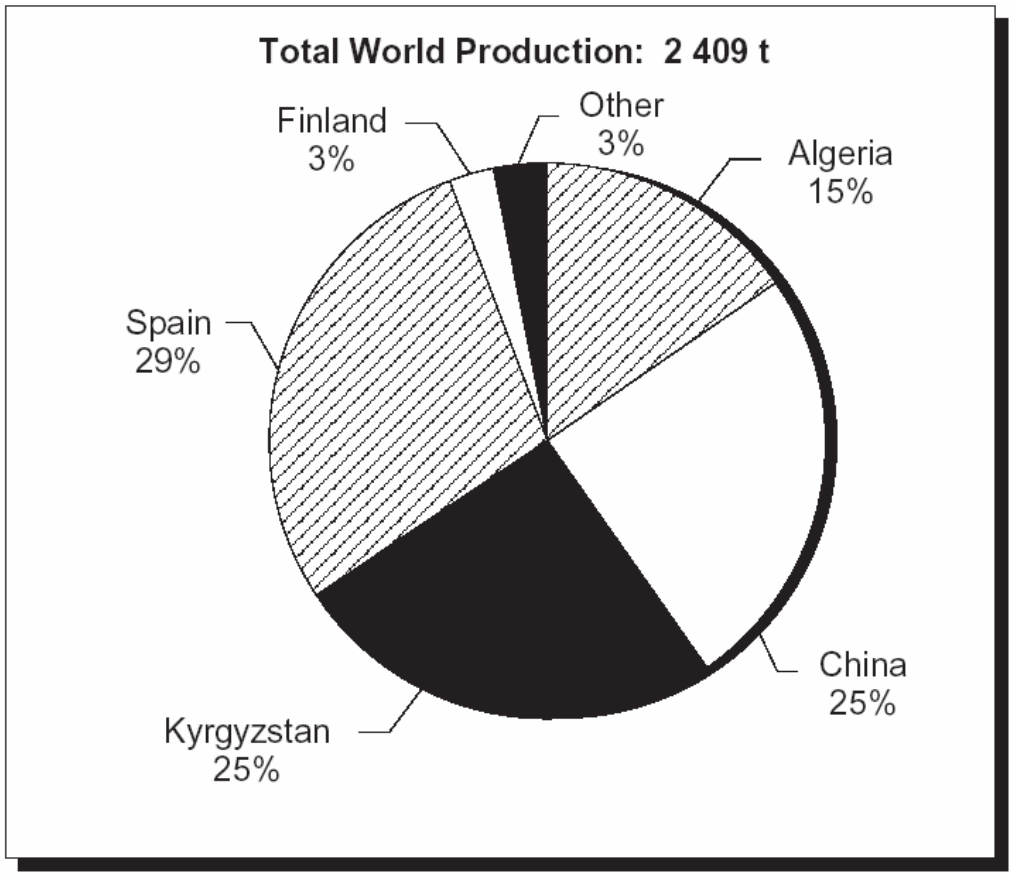
STC 'Sintez', Institute of Electrophysical Apparatus, St.Petersburg

http://www.niiefa.spb.su/

Producing EM pumps for 230 m^3/h Sodium

Experts should work on this. We ask them!

Mercury production



Source: International Consultative Group on Nonferrous Metals Statistics.

http://www.nrcan.gc.ca/mms/cmy/content/1998/38.pdf

Year 1997: 2409 ton

SNS mercury flow

- mass flow = 340 kg/s
- v_{max}=3.5 m/s
- centrifugal pump
- Pump power = 56 kW
- http://puhep1.princeton.edu/mumu/target/Hg_issues.PDF