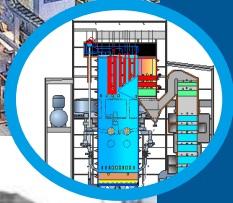


Pertti Koukkari

- M.Sc (Chemical Engineering), Helsinki University of Technology 1978-1985

10 years in chemical industry
1985-1995

- Ph.D. in physical chemistry (thermodynamics) 1995
- 1995 start at VTT, since 2009 VTT Research Professor (retired III/2023), XAMK R&D from July 2023



Biogeeninen hiilidioksidi ja karbonointiteknologiat

Pertti Koukkari

Carbon dioxide for papermaking - 2001

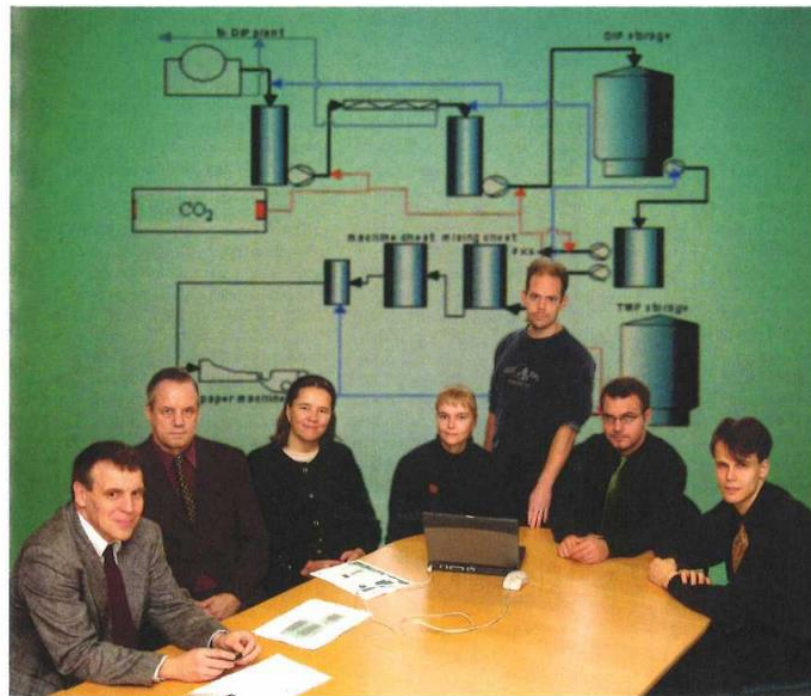
Kemia-Kemi Vol. 29 (2002)

Hiilidioksidi hyötykäyttöön paperitehtaassa

UPM-Kymmene, AGAn ja VTT:n kehittämä tekniikka yleistyy Euroopassa

PERTTI KOUKKARI,
HEIKKI PAKARINEN ja
HANNU LEINO

- Paperikoneiden neutraali-konversio 2000-luvun vaihteessa
- CO₂-puskurointi ja Ca-kemian hallinta

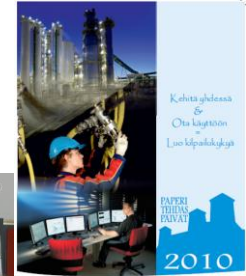


NEW: pH in pulp suspensions

In-line PCC - 2010

New concepts for papermaking chemistry

- Development of in-situ PCC chemistry by injection of CO_2 and lime milk
- Simultaneous reaction and enhanced mass transfer with TrumpJet® mixers
- Developers: Wet End Technologies and UPM with VTT as research partner
- Reduction of water consumption & improved energy efficiency
- Reduction of investment cost for a paper-machine with 20 M€

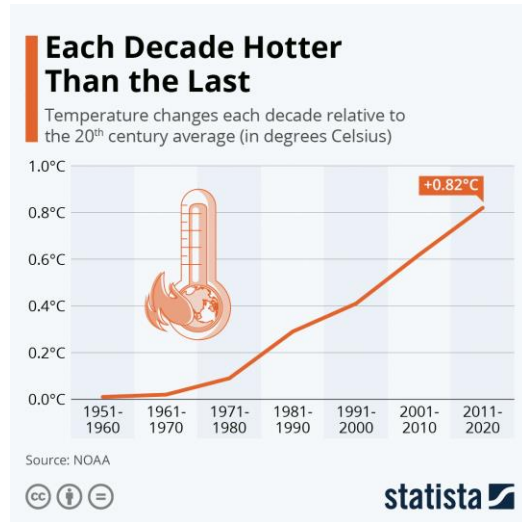


NEW: reaction dynamics in multi-phase suspensions



CO₂ is in the air – not in the market ?

- 65 % of global warming due to CO₂ in the atmosphere



- Lack of pure CO₂ in the market:

4.10.2022 11:35 | KEMIA

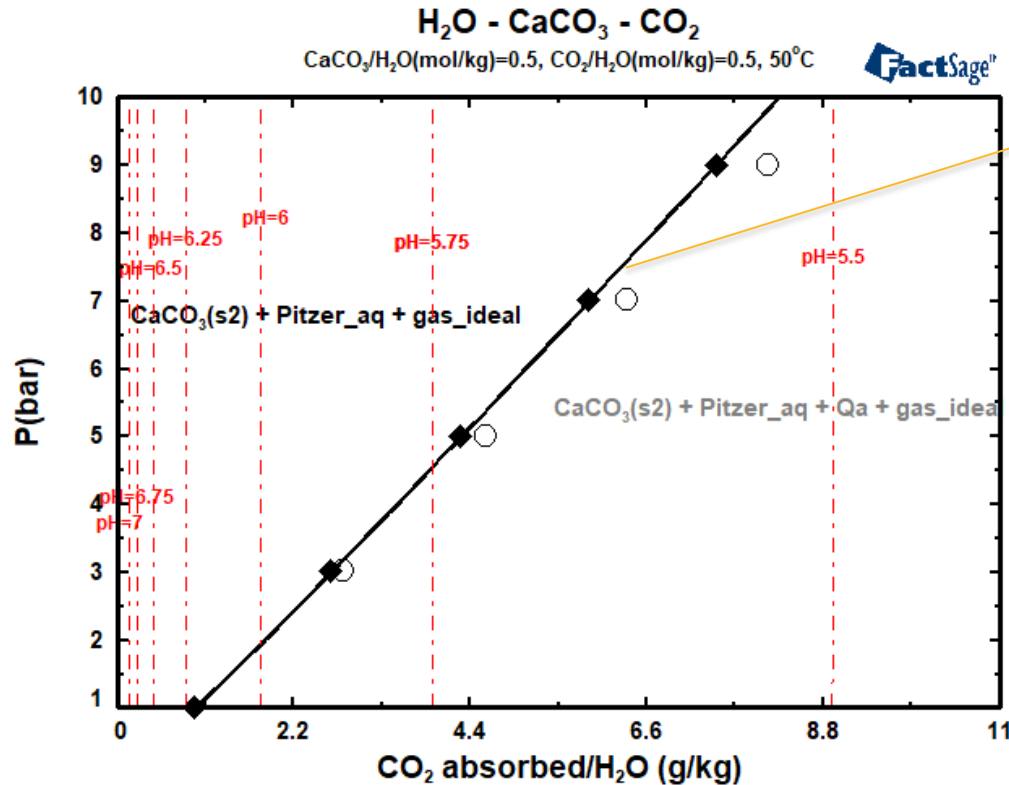
Metsä Group ja Fortum yhteistyöhön metsäteollisuuden tuotannon sivuvirtana syntyvän hiilidioksidin hyödyntämiseksi
Metsä Group Lehdistötiedote 27.3.2023 klo 14

Eurooppaa koettelee yhä hirveä CO₂-pula:



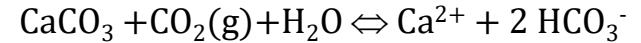
- Expected growth
3.5 => 23 Mrd€
(2021 => 2027)

Absorption vs. P -diagram of the CO₂-H₂O-CaCO₃ -system



The saturation limit indicates the equilibrium solubility of CaCO₃

Dots show the CO₂ absorbed when using solubility (equilibrium) data of the reaction:



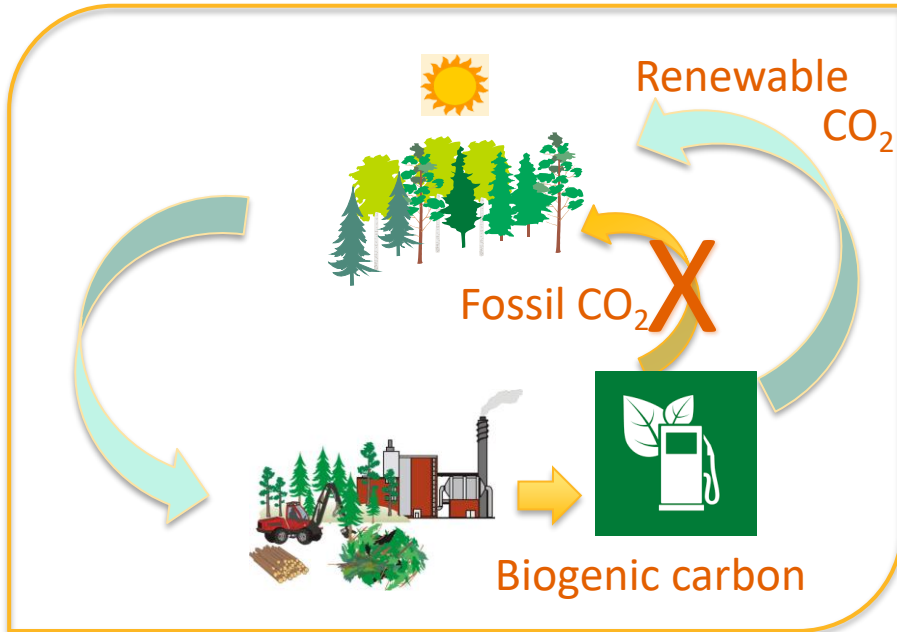
Solubility data:

◆ FactSage

○ VTT Technology 321

With the mass balance data directly available the Extent of Absorption-diagrams appear as practical tools for the CO₂-capture process development

Summary: towards a biogenic carbon cycle



- Carbonaceous substances are a necessary utility in both industry & human infrastructure
- New innovative cross-industrial solutions make use of renewable carbon sources
- With existing forest industry side stream volumes, a sustainable biogenic carbon cycle is conceivable in Finland
- Recent changes in the business environment support this change



**Tunne huomisen.
All for the future.**

