DEVELOPMENT OF CHEMICALLY BONDED CERAMIC BOREHOLE SEALANTS

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Presented at
Natural Gas and Oil Technology Partnership meeting
Houston, November 16, 1999.

Chemically Bonded Ceramics

- Ceramics formed by chemical reactions at room or warm temperatures.
- Products processed like cements, properties superior to cement.
- Binder reaction:
  $MgO + KH_2PO_4 + 5H_2O$ --------> $MgKPO_4.6H_2O$
- Ash improves structural properties, reduces costs, and is a part of the binder composition.

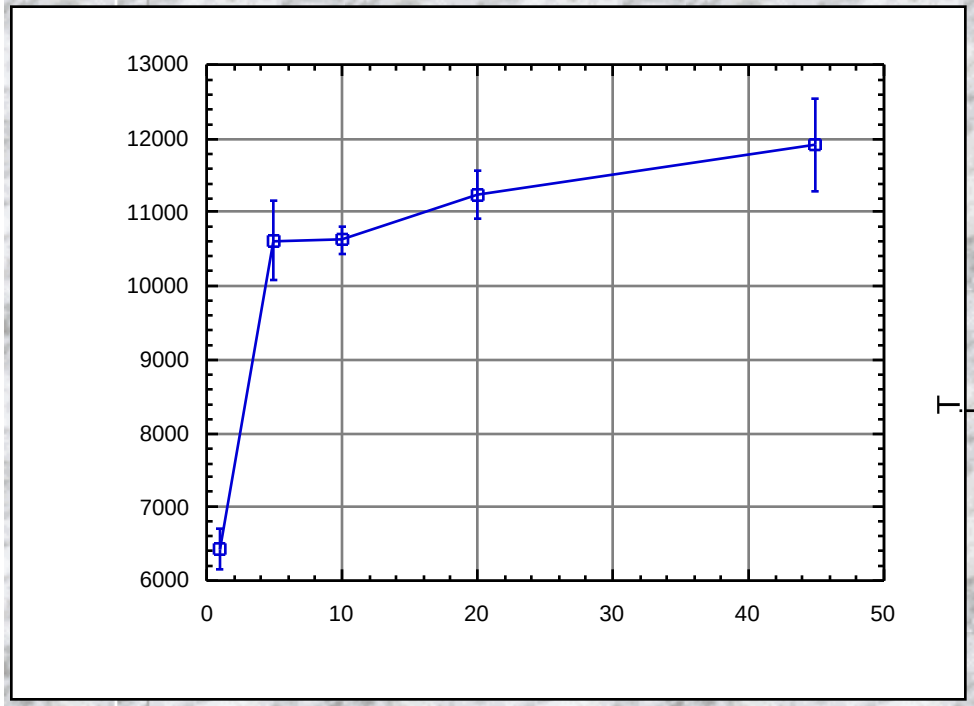
STATUS OF TECHNOLOGY

- $4 million development funded by DOE's EM program.
- Won R&D 100 award in 1996.
- Current projects include
  - Full-scale demonstrations for radioactive waste
  - Structural products.
- Approved by DOTs of northern states as road repair material and marketed commercially.
- Patents and Inventions
  - Three granted to ANL
  - One filed by ANL, two by DOE
  - One on oil field applications filed by LANL.

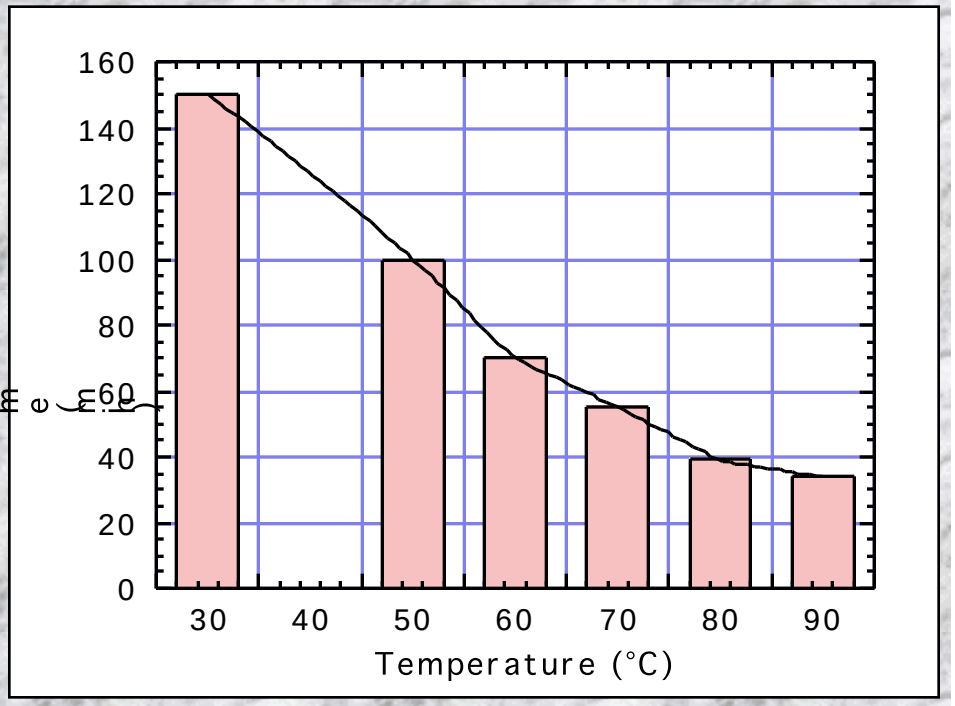
ATTRIBUTES

- **Superior rapid-setting cement grout.**
  - ***Sets under water.***
  - ***Setting behavior is controllable.***
  - ***Does not set while in motion.***
- **Sets in presence of hydrocarbons and chlorides.**
- **Low-viscosity, pumpable sealant.**
- **High-strength, low-porosity material, but drillable.**
- **Self-bonding, bonds to any material except plastic.**
- **Temperature-tolerant setting.**
- **Expands slightly while setting; an ideal sealant.**
- **Uses conventional equipment.**

SETTING CHARACTERISTICS

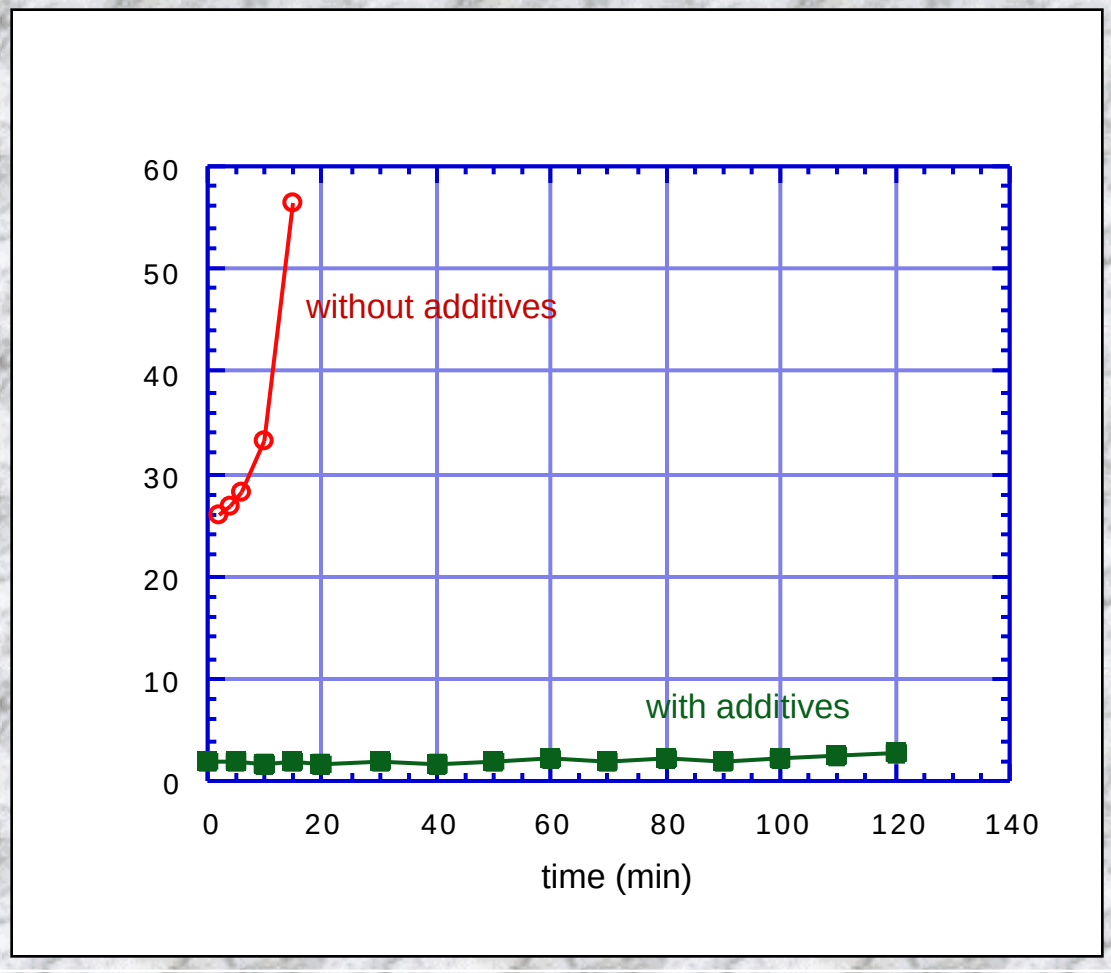


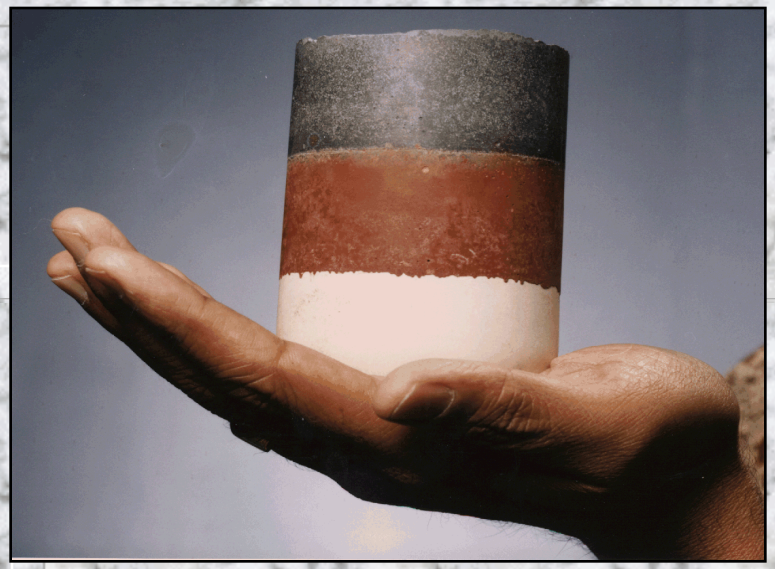
Strength gain at room temperature



Setting time at subsurface temperatures

VISCOSITY

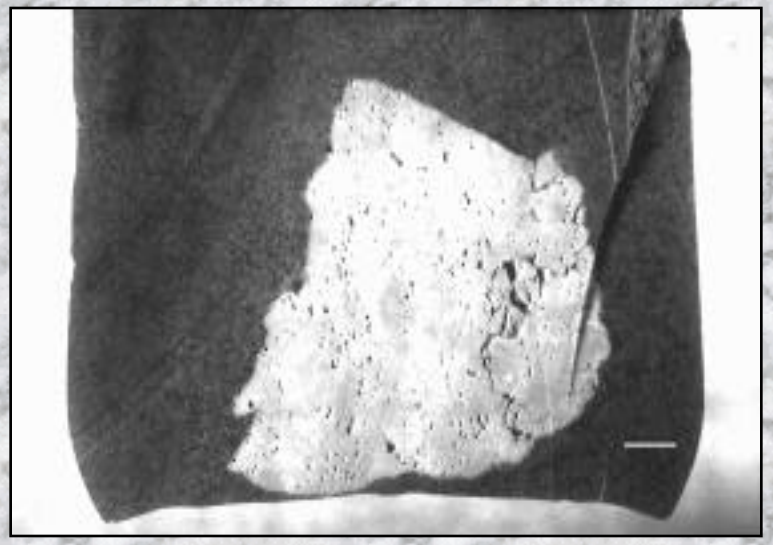

Viscosity (X 1000 cp)
60
50
40
30
20
10
0
without additives
with additives
0
20
40
60
80
100
120
140
time (min)



Bonds to itself

Sets under water

Drillable



Bonds to rock

PROPOSAL TASKS

- Study of setting characteristics with API standard tests (FY00).
  - Use of consistometer.
  - Setting time as a function of slurry composition, temperature, and pressure.
  - Viscosity and yield stress during setting.
- Development of fiber composites, expandable sealants (FY00).
- Prototype designs for applications (FY00).
- Bench-and pilot-scale testing and optimization of formation (FY01).
- Field-scale testing (FY02).
- Licensing agreements (FY02).

COLLABORATION & FUNDING

- ANL and LANL will jointly conduct the effort.

- Industrial partners - Chevron, Global Petroleum Research Institute.
  - Make available consistometer and unique facilities.
  - Advise on user needs.
  - Collaborate in search for field trial candidates.

- DOE funding requested: $400K each year for 3 years.