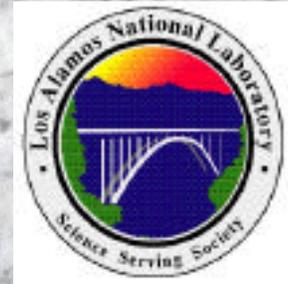




# DEVELOPMENT OF CHEMICALLY BONDED CERAMIC BOREHOLE SEALANTS



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# Chemically Bonded Ceramics

- **Ceramics formed by chemical reactions at room or warm temperatures.**
- **Products processed like cements, properties superior to cement.**
- **Binder reaction:**  
$$\text{MgO} + \text{KH}_2\text{PO}_4 + 5\text{H}_2\text{O} \text{ -----} \rightarrow \text{MgKPO}_4 \cdot 6\text{H}_2\text{O}$$
- **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.**

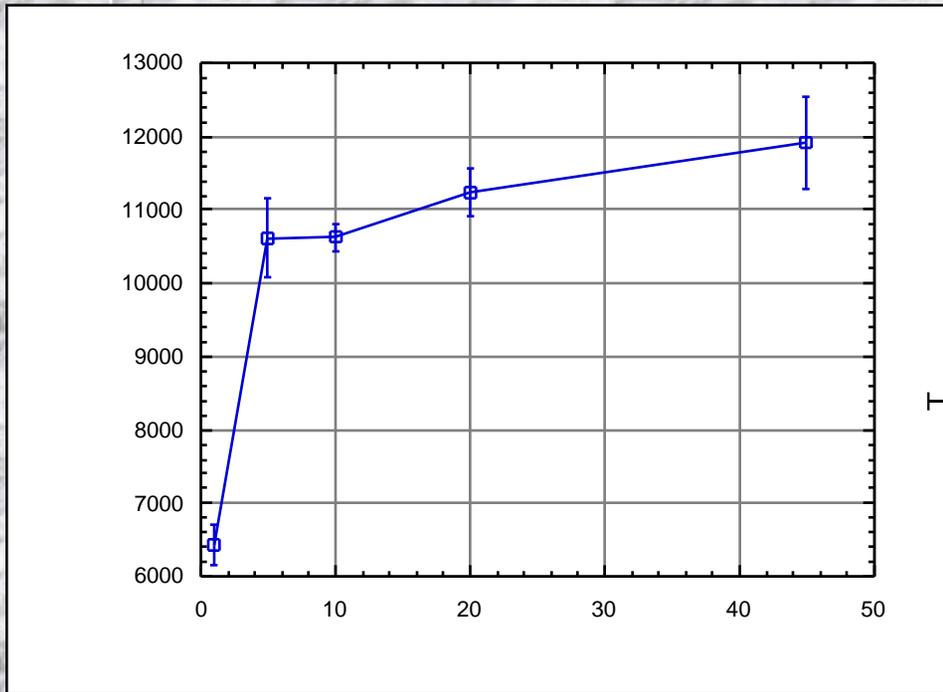


# ATTRIBUTES

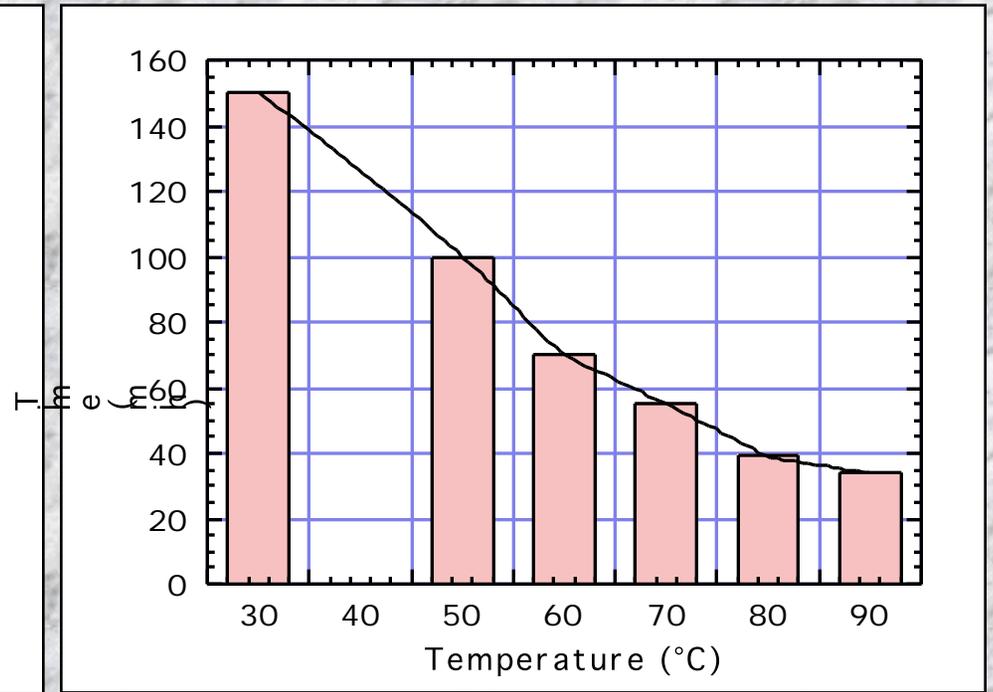
- **Superior rapid-setting cement grout.**
  - *Sets under water.*
  - *Setting behavior is controllable.*
  - *Does not set while in motion.*
- **Sets in presence of hydrocarbons and chlorides.**
- **Low-viscosity, pumpable sealant.**
- **High-strength, low-porosity material, but drillable.**
- **Self-bonding,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



# SETTING CHARACTERISTICS



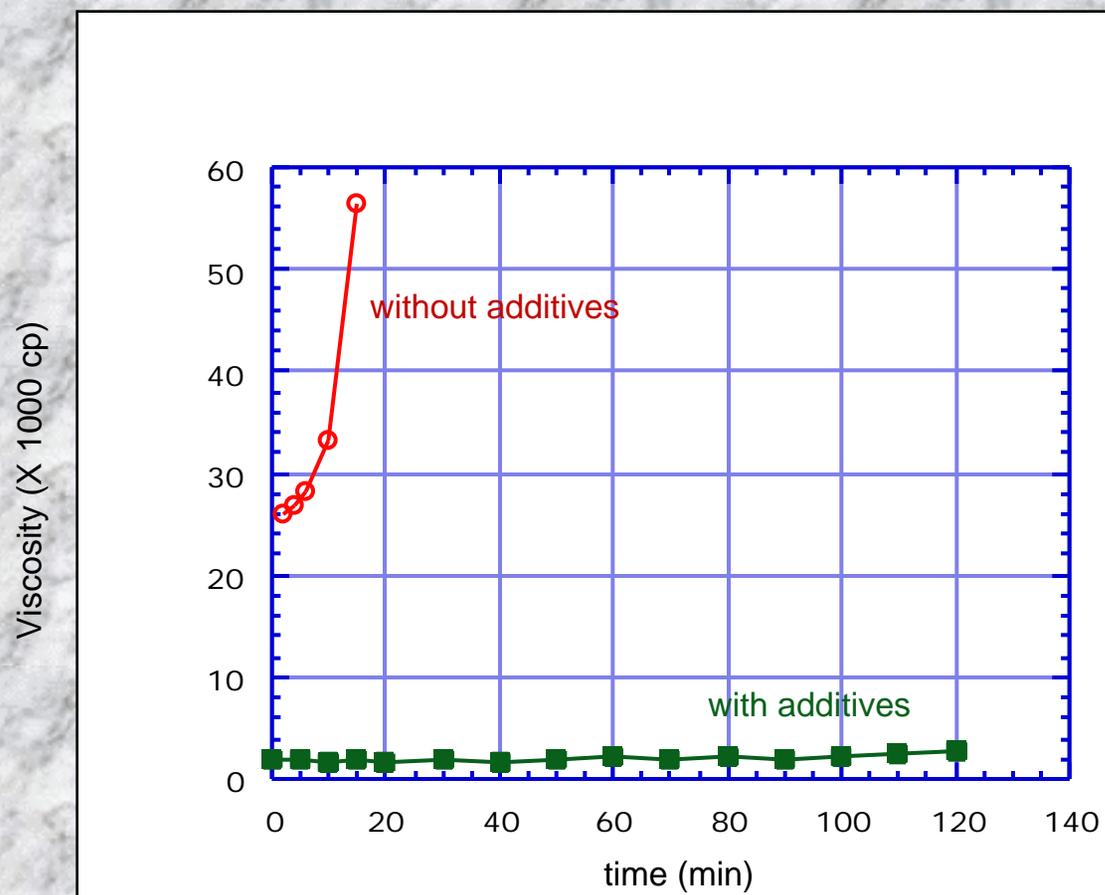
Strength gain at room temperature



Setting time at subsurface temperatures



# VISCOSITY





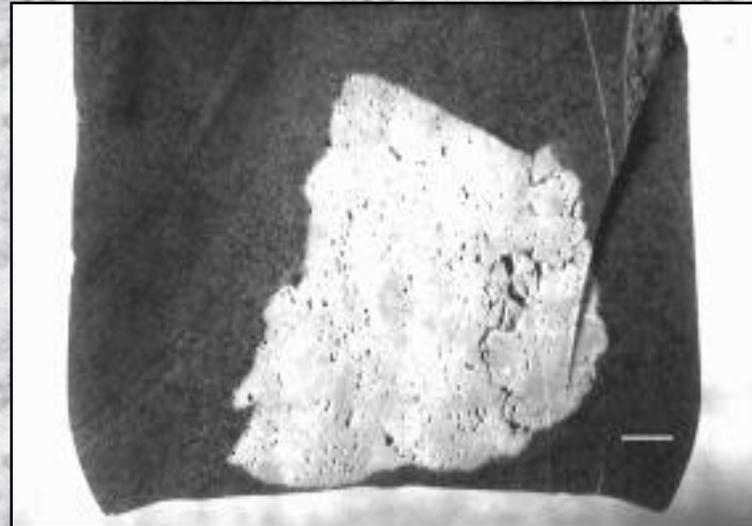
Bonds to itself



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.**

