Feasibility Studies of Direct CO_2 Sequestration with Minerals

Project areas to be mentioned--

- Development of a pipe-line reactor
- Feasibility studies of approach for the direct CO_2 sequestration with minerals
- Contractor process simulations and cost evaluation

Reactor types that we are studying —

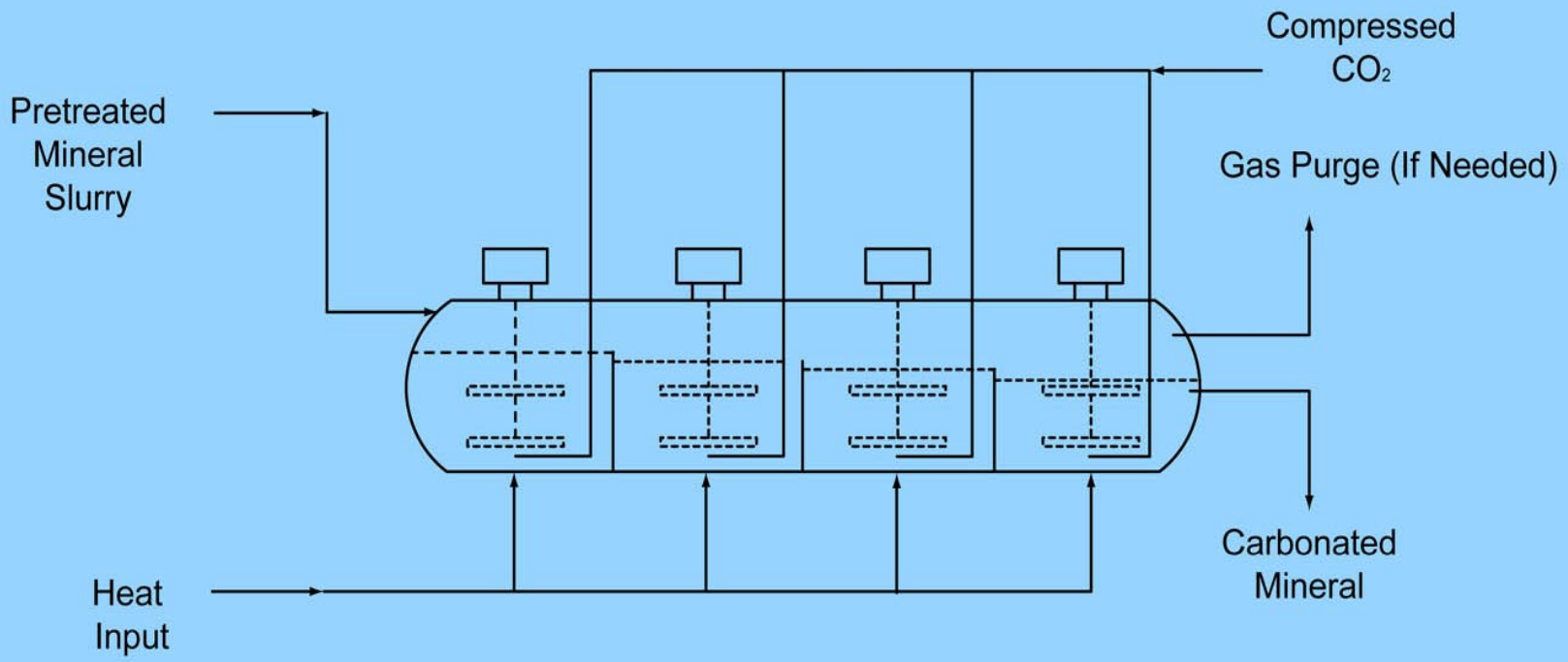
- Conventional
- Pipe-line

Carbonation reactor considerations—
(At a given temperature and pressure

- Wall thickness of pressure vessels is directly related to the diameter of the vessel
- Cost of vessel is directly related to the wall thickness
- From a cost standpoint, its desirable to use small diameter, thin-walled vessels (e.g., pipes)

Conventional Reactor

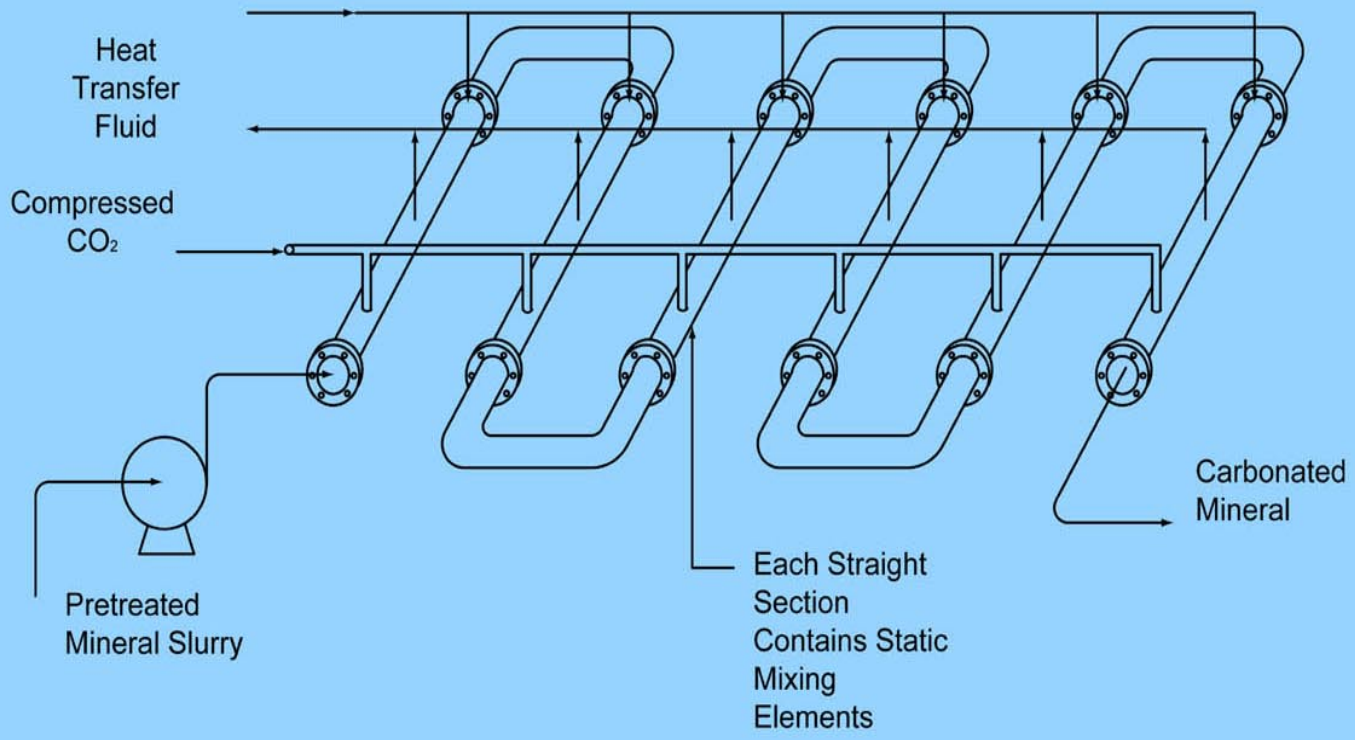
(Continuous-Flow Leach-Type Autoclave)



Carbonation Reactor Conditions:
1 - Hour Residence Time
2,300 psig
155˚C

Proposed Conceptual Reactor

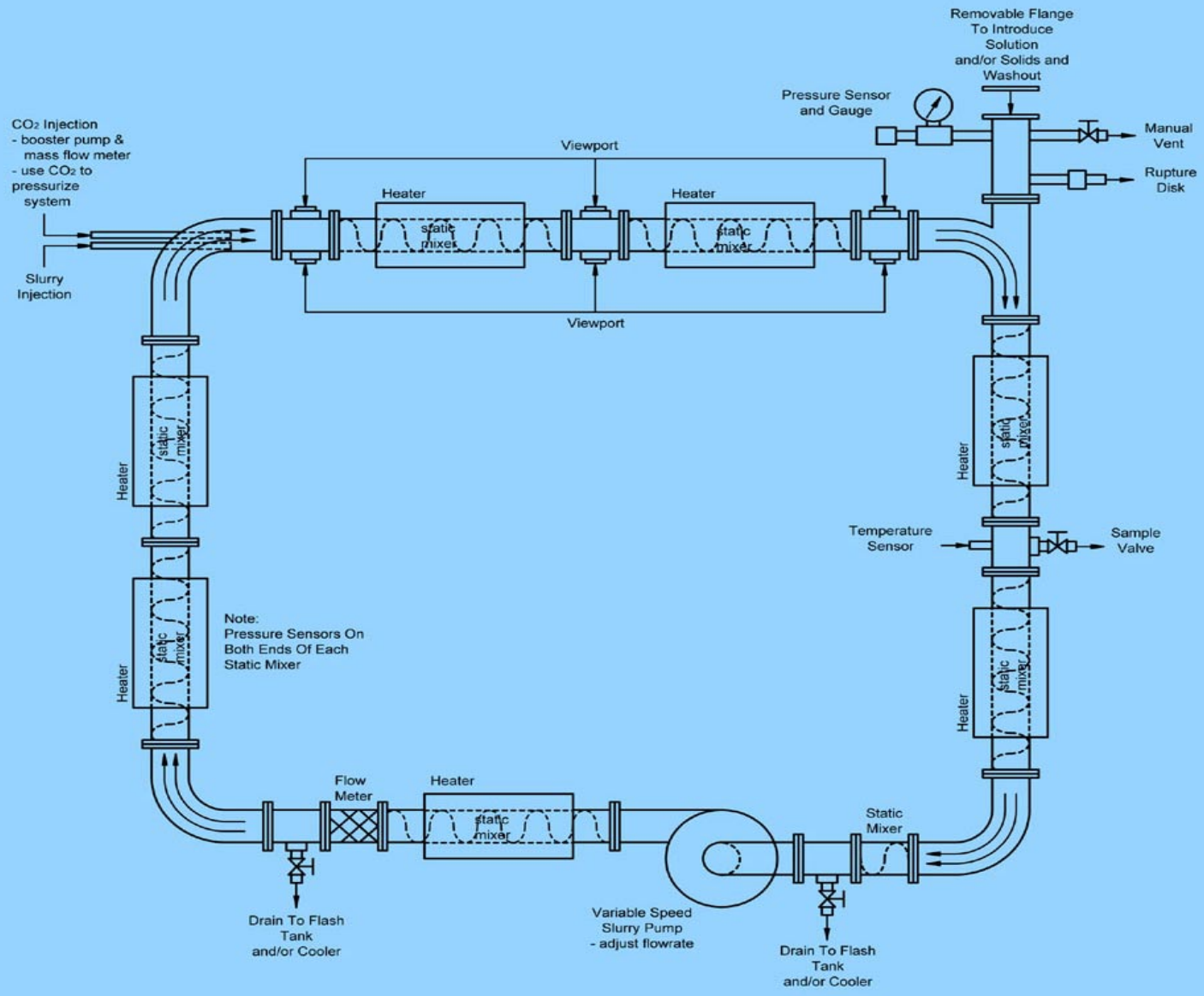
(Pipe-Line Flow-Through Reactor)



Picture of lab test bench for static mixers—

Picture of small lab static mixer—

Conceptual Pipe - Line Reactor



Examples of data needed from lab-scale pipe-line (loop) reactor —

- Energy consumption
- Optimized slurry density
- Operational parameters
- Required mixing intensity (solids suspension and gas dispersion)
- Attainable extent of reaction
- Materials of construction (corrosion and wear)
- Optimum mixer designs (3-phase mixing)

Approach under study for direct CO_2 sequestration with minerals —

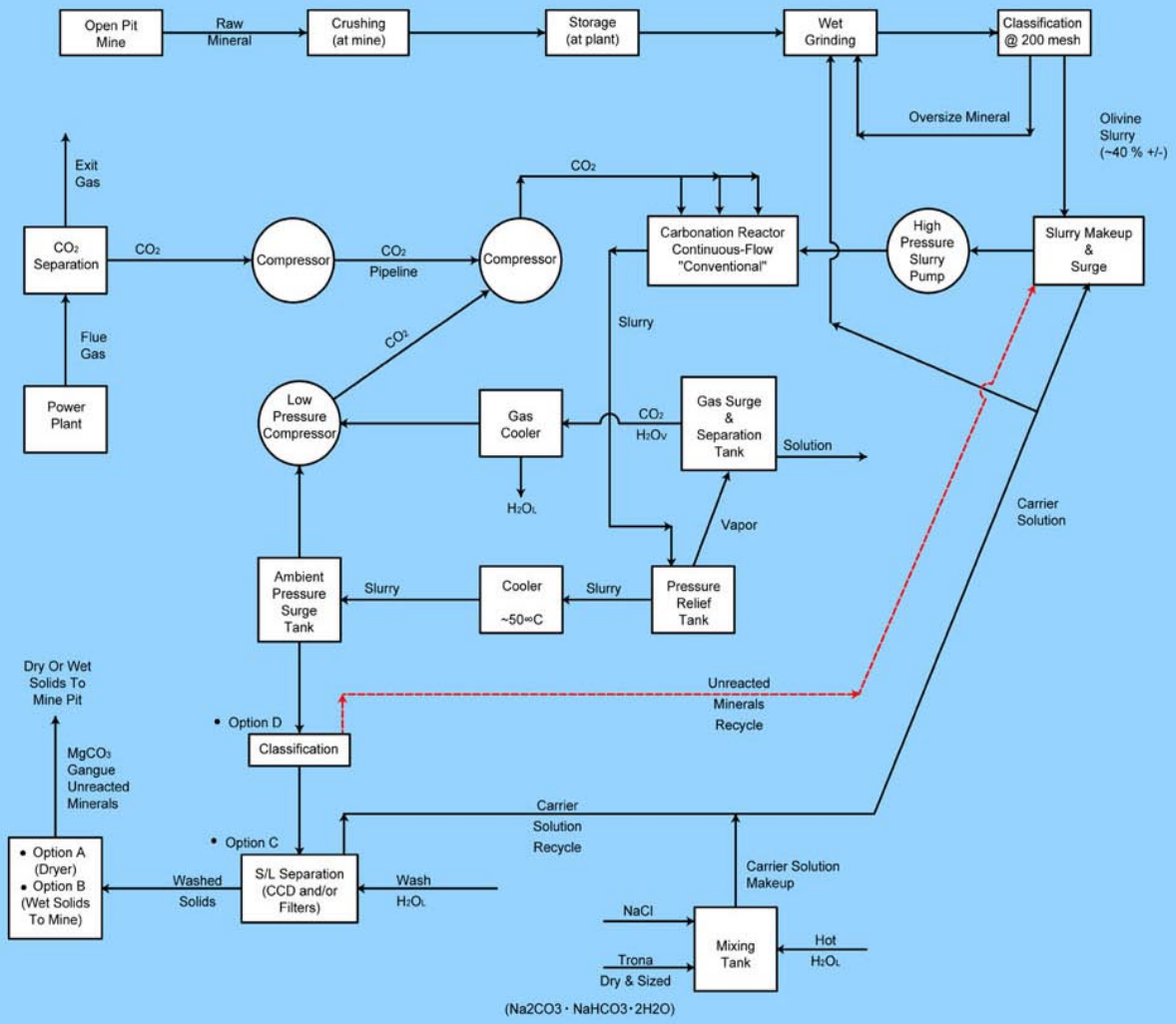
(Principal assumptions)

- Process CO_2 from a 1 GW coal-fired power plant (24 kt/day)
- Olivine mineral used (equivalent to 49% MgO)
- 80% utilization of Mg in mineral each pass
- Plant located at mineral deposit (Twin Sisters, WA)
- CO_2 captured, separated, piped from Centralia, WA, power plant

Cont'd Approach under study for direct CO_2 sequestration with minerals —

- Carbonation reactor parameters:
  - 1 hr residence time
  - 2,300 psig
  - 155 °C
  - 30% slurry
  - -200 mesh mineral
  - Carrier soln (0.64 M $NaHCO_3$ + 1 M NaC1)

CO_2 Sequestration With Olivine



Some of the principal materials handled in the process —

Stream name	Amount (metric tons/hr)
CO_2	1,000
Mineral to process	2,337
Reactor product (dry)	3,337

	Amount (gal/min)
Slurry flow rate to reactor	26,000