

## Technology Available For Licensing/Co-development

### Efficient Manufacturing Process For Na-LSX (13 X) & Li-LSX Zeolite

- CSIR-NCL has developed an end-to-end process to synthesize high-crush strength binderless **zeolite granules of Na-LSX (13 X) & Li-LSX** with sizes ranging from 0.7 to 3 mm
- Product has been benchmarked by third party against commercial zeolites on adsorption testbeds as well as in oxygen concentrator
- Na-LSX has also been evaluated by third party for selective CO<sub>2</sub> adsorption from pure gases & mixtures (synthetic reformat and biogas)
- The process is optimized & validated at 1 kg scale

### Background

- Zeolites are microporous crystalline aluminosilicate used commercially as adsorbents, ion exchangers & catalysts
- Pressure swing adsorption using Na-LSX / Li-LSX zeolite is a simple & affordable technique to separate gaseous mixtures like air & biogas

### Tech Offering

A binderless process for the synthesis of Na-LSX (13 X) & Li-LSX zeolite

#### Product specification (Li-LSX):

- Phase Purity by XRD: Pure 13X type Zeolite
- N<sub>2</sub> Adsorption of Na-LSX granules (ml/g): 9.0
- N<sub>2</sub> Adsorption of Li-LSX granules(ml/g): 20-21
- Granule Size (mm): 0.7 to 3.0 or higher
- Granule Crushed Strength (N/mm<sup>2</sup>): 4.00
- O<sub>2</sub> purity in VPSA (%): 93 (±3)

#### NCL Na-LSX Zeolite breakthrough data

Gases	Adsorption capacity (mL/g)
Pure CO <sub>2</sub>	105
Pure H <sub>2</sub>	4.2
Pure CH <sub>4</sub>	15
CO <sub>2</sub> /CH <sub>4</sub> (40%/60%)	CO <sub>2</sub> – 69; CH <sub>4</sub> – 7
CO <sub>2</sub> /H <sub>2</sub> (25%/75%)	CO <sub>2</sub> – 80; H <sub>2</sub> – 4

### Applications

- Li-LSX is used to make medical-grade oxygen with 93% purity
- Na-LSX is used for selective CO<sub>2</sub> adsorption from biogas stream & for gas purification

### Market Potential

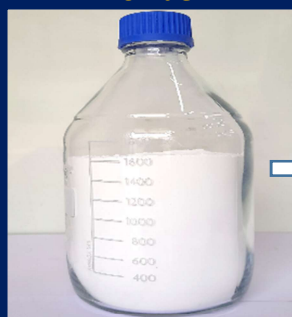
- Zeolite market size is projected to grow from \$4.28 billion in 2022 to \$5.71 billion by 2029, at a CAGR of 4.2%

(<https://www.fortunebusinessinsights.com/industry-reports/zeolite-market-101921>)

### Value Proposition

- Gel ageing free process
- Innovations in binderless process
- One step Crystallization (100% pure X type)
- Efficient downstream recovery operations
- Control on zeolite LSX composition, size

NCL Na-LSX Zeolite Powder



NCL Li-LSX zeolite Granules



### Current Status

- Process has been demonstrated & validated at 1 kg scale
- Technology is available for licensing/co-development
- IP: IN202211044092, IN202211001902