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# Development of Extruder Formulations for Shaped Alumina and Zirconia

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**Alvacat**
*Catalysis from Bench to Market*

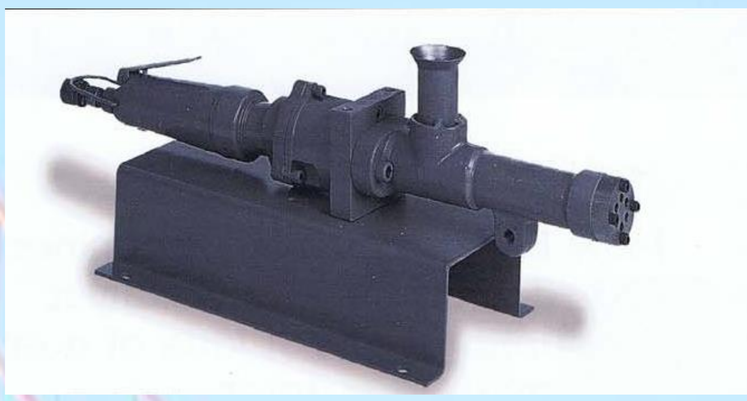
## Company Profile

- Contract research
- Heterogeneous catalysis, Materials science
- Renewables
- Environmental catalysis
- Hydrogen storage catalysis
- Energy storage, Battery materials

- Custom catalyst and support development
- Lab scale, bench scale and scale up
- Catalyst carrier and solution inventory
- High throughput synthesis and screening
- Partnered with tollers for scaleup, piloting, manufacturing and metal recycling

## High Throughput Recipe Development in Lab Scale Extruder

**High Torque Bonnot BB Gun Extruder**



Smallest Bonnot catalyst extruder

100g scale

Rapid screening of formulations

Table mounted or hand held

Scalable recipes

## Results I – Zr-doped $Al_2O_3$

1mm **$Al_2O_3$-1%$ZrO_2$** extrudates

| crush strength | wet capacity |
|---|---|
| 30 N/mm | 0.65 ml/g |
| 25 N/mm | 0.7 ml/g |
| 20 N/mm | 0.8 ml/g |
| 15-20 N/mm | 0.9 ml/g |

Variation of Zr precursor, peptization agent, binder, lubricant, porogen

## Results II – alumina and zirconia extrudates

| | diameter | crush strength | wet capacity |
|---|---|---|---|
| NorPro SA31176 | 3 mm | 25 N/mm | 1 ml/g |
| Clariant CS332 | 1.5 mm | 20 N/mm | 0.9 ml/g |
| Sasol Catalox | 1.5 mm | 20 N/mm | 0.75 ml/g |
| Alva Aldat 1-25 | 1 mm | 25 N/mm | 0.8 ml/g |
| Alva Aldat 1-35 | 1 mm | 35 N/mm | 0.7 ml/g |
| NorPro SZ31164 | 3 mm | 15 N/mm | 0.29 ml/g |
| Alva Zirdat 15-25 | 1.5 mm | 25 N/mm | 0.4 ml/g |
| Alva Zirdat 08-45 | 0.8 mm | 45 N/mm | 0.15 ml/g |

## Specs & Scale up

**High Crush Strength Extrudates**

- Proprietary generic extrusion recipe
- Alumina, zirconia, titania, carbon
- Stronger extrudates than prior art
  at somewhat lower wet capacity
- Fine tune porosity
  by addition of porogens
- Inventory of porogens
- Crush strength & wet capacity correlated:
  0.1ml/g higher WC = 5N/mm lower CS

## Conclusions

**High throughput recipe development of shaping formulations for alumina and zirconia extrudates**

- High throughput screening of peptization agents & extrusion aids
- Bound & binderless formulations
- Variety of non-cellulosic additives
- Developed extruder recipes for alumina and zirconia with remarkably high crush strength
- Crush strength as high as 35N/mm for Aldat and 25N/mm for Zirdat porous catalyst supports
- Samples available upon request