SAIMM
2017

Senmin International (Pty) Ltd

GOING GREEN

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AECI Values
BIGGER

BOLD	PUSHING OUR PERFORMANCE ABOVE AND BEYOND.
INNOVATIVE	ACTIVELY CHALLENGING OURSELVES TO REINVENT WHO WE ARE, WHAT WE DO AND HOW WE DO IT.
GOING GREEN	DRIVING SOLUTIONS FOR A SUSTAINABLE FUTURE.
ENGAGED	BEING COMMITTED TO A CULTURE OF ACCOUNTABILITY, HONESTY AND INCLUSIVITY.
RESPONSIBLE	ACTING IN A MANNER THAT IS MINDFUL OF ALL STAKEHOLDERS' INTERESTS.

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Food for thought…..

"If you always do what you always did then you will always get what you always got"

Doing the same as last year and

Expecting different results!!!!

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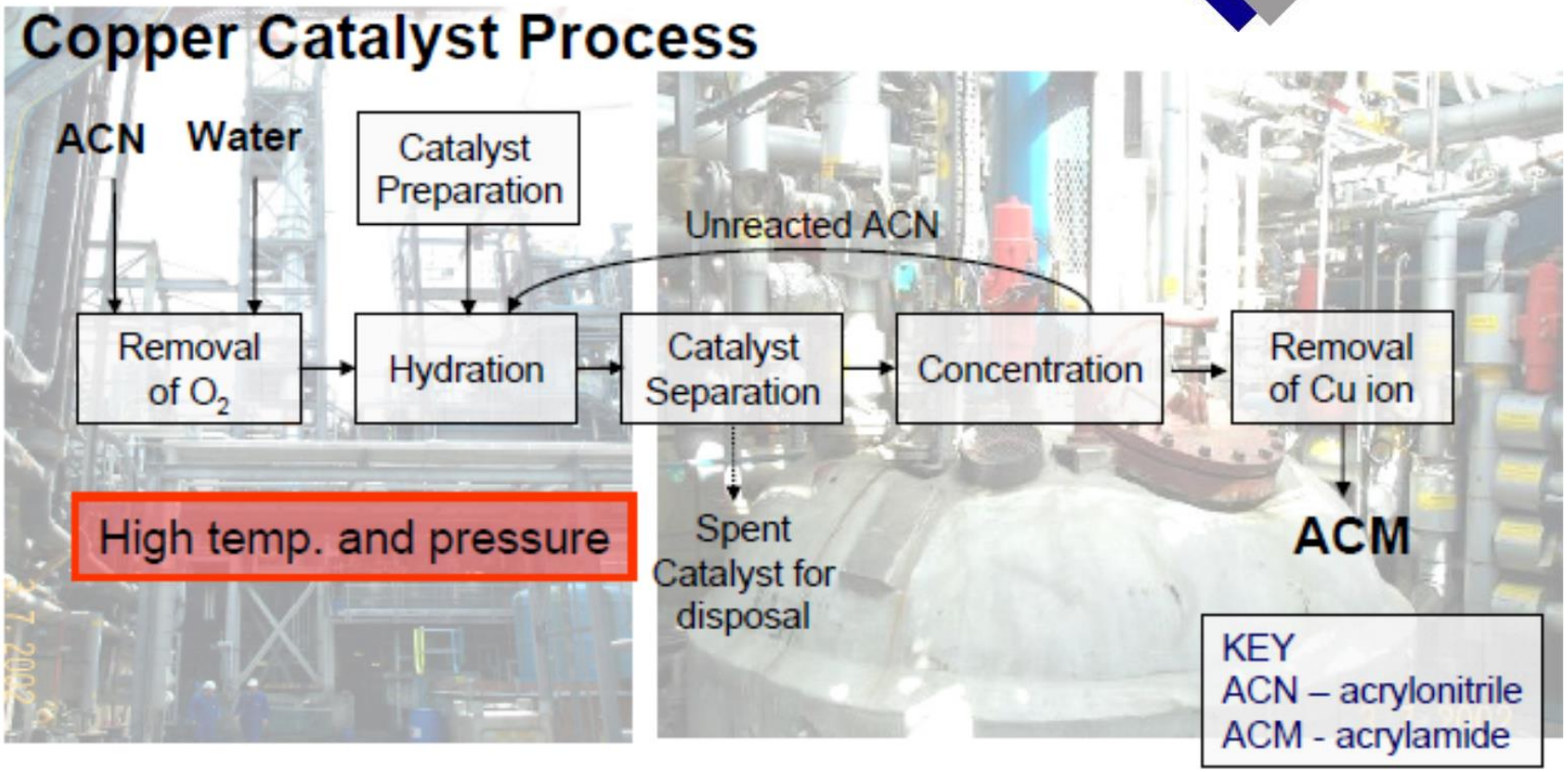
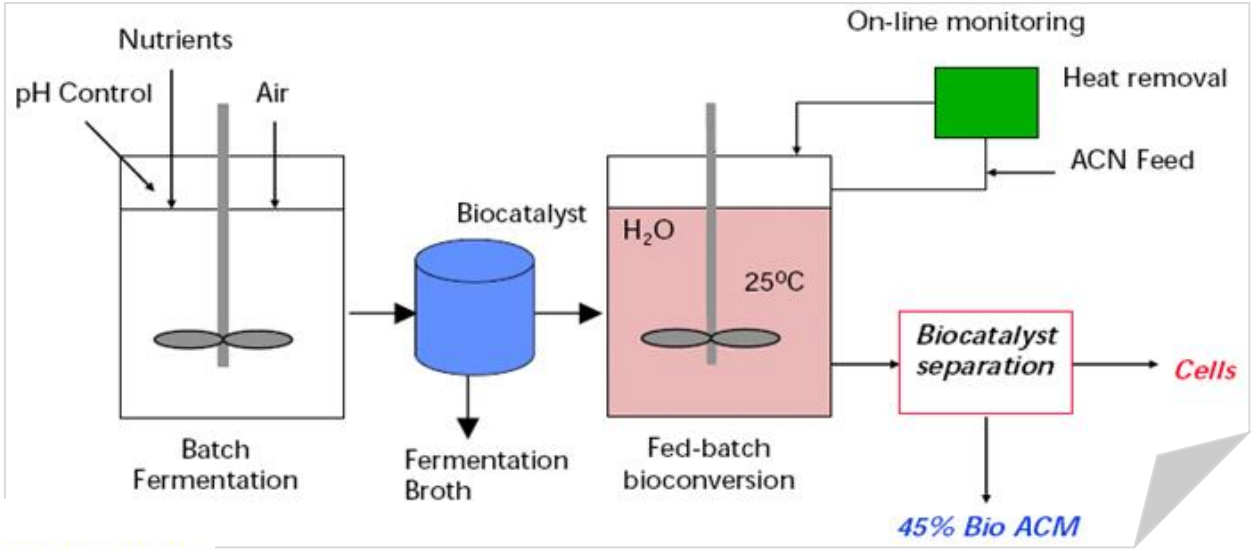
Polyacrylamide Production Catalyst Process



- Uses specific grade of Acrylonitrile
- A significant part of the process is removal of the catalyst and subsequent purification of ACM

Bio Acrylamide Process

- The Bio acrylamide process has four key stages:
  - Bio fermentation- to grow the biocatalyst (bacteria to enzyme catalyst)
  - Separation of the biomass from the fermentation broth
  - Bioconversion using the biocatalyst (enzyme) to convert ACN to ACM
  - Separation of the enzyme (reusable) from the ACM product



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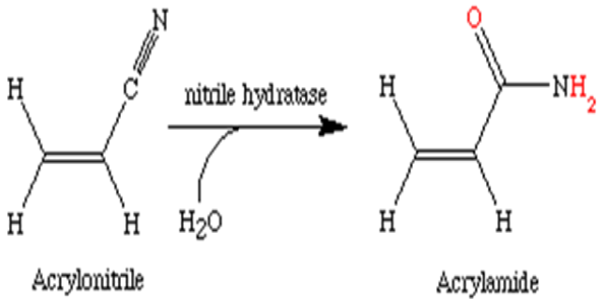
Bio conversion plant



Comparison of Processes

- **Conventional Process**
  - Complex reaction and process : **high temperature and high pressure**
  - Difficult to prepare and recover catalyst : extremely hazardous
  - Difficult to separate and purify product ACM
  - Environmentally not favourable wrt to energy input and disposal of spent catalyst
- **Bioconversion Process**
  - Fundamentally simple reaction
  - Inherently safer reaction : **ambient temperature and atmospheric pressure**
  - Safer plant which is more environmentally friendly
  - Smaller plant foot print for same production capacity
  - Low catalyst costs… as you grow your own
  - Bioconversion is a very robust process
  - Produces a higher quality ACM with few by-product impurities
  - More cost effective
  - Almost zero effluent
  - Bio waste is sought after by Sasol

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Carbon Disulphide Life Cycle Study

There are two production processes :

1. the charcoal process

   $C + S_2 \rightarrow CS_2$ @ > 750 ^oC

2. the methane process

   $CH_4 + 4S \rightarrow CS_2 + 2H_2S$ @ 600 to 630^oC

3. Similarities are the use of three sources of energy used, namely electricity from the grid for plant equipment operations, steam for the blanketing of sulphur pits and pipeline + the use of fuel gas for flaring

4. A pivotal improvement in the methane process is the recovery of sulphur contained in the H_2S gas stream using a conventional Claus process, where H_2S is converted to elemental sulphur in two-stages, represented by the reactions

   - $2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O$
   - $SO_2 + 2H_2S \rightarrow 3S + 2H_2O$

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The Production Process

CS_2 Facility (Senmin ®)

Old process

$C + S_2 \rightarrow CS_2$

@ 750-900 ^0C

New process

$CH_4 + 4S^0 \rightarrow CS_2 + 2H_2S$

$2H_2S + O_2 \rightarrow 2S^0 + 2H_2O$

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Xanthate from CS_2

$ROH + CS_2 + KOH \rightarrow ROCS_2K + H_2O$

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LCA – Life Cycle Analysis

1. Central to the LCA methodology is the “cradle to grave” system boundary that ensures that impacts across the entire life cycle of a product are included in the analysis.
2. Five impact categories were selected for this assessment, namely;

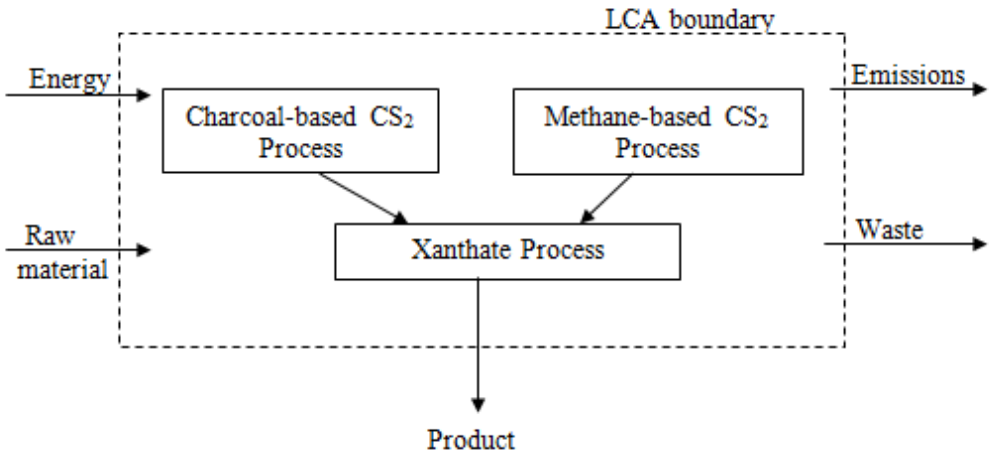
   Climate change - Global warming due to greenhouse gas emissions in the atmosphere

   Fossil fuel depletion - Non-renewable resource depletion due to extraction and consumption of fossil fuels

   Acidification - Change of acidity in the soil by acid rain due to gaseous SO_2 emissions

   Human toxicity - Effects of toxic substances on human health.

   Ecotoxicity - Damage to ecosystem quality as a result of emission of toxic substances to air, soil and water.



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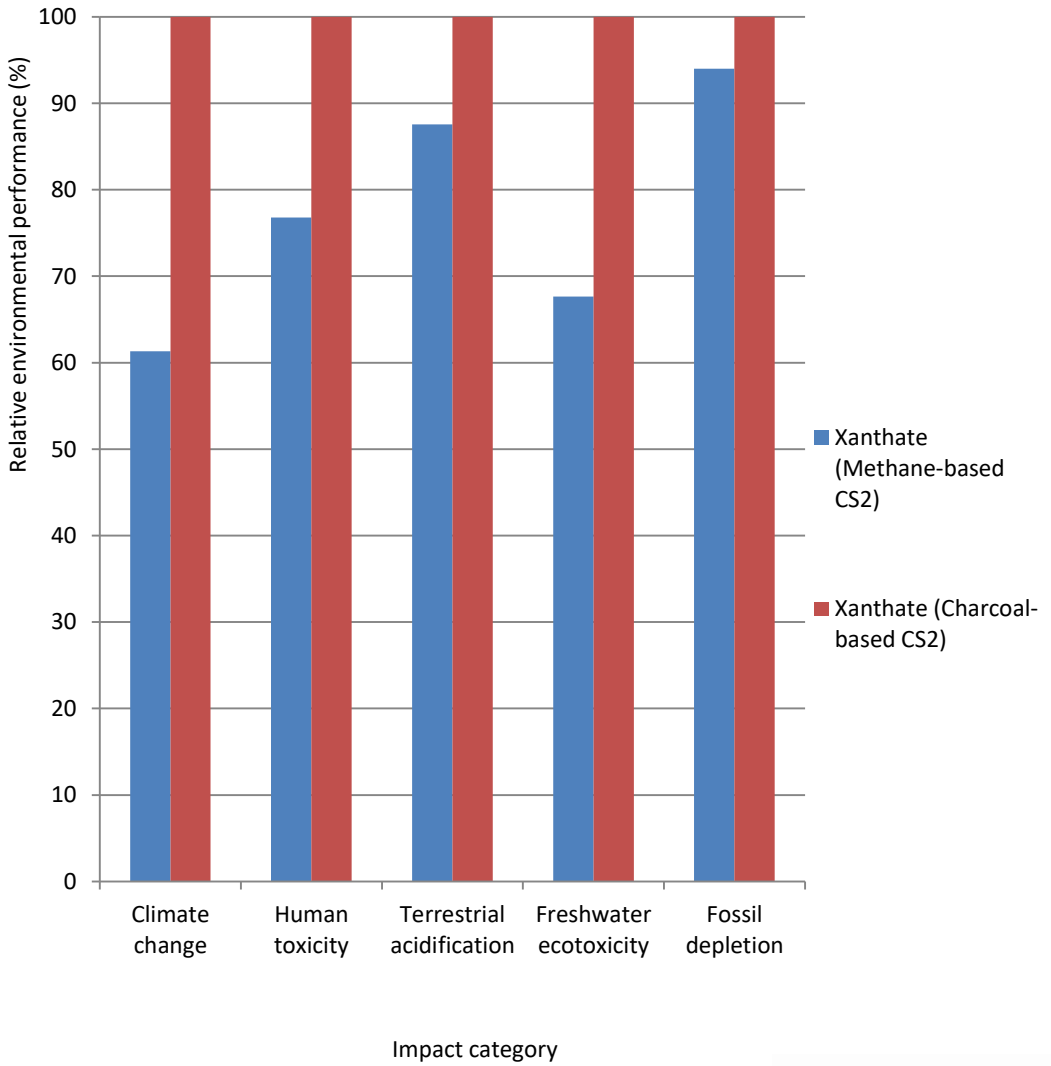
LCA outcome

Using 1 ton of CS_2 process (functional unit) to produce liquid xanthate, the LCA results in the accompanying figure show that xanthate produced via the methane-based CS_2 process route has a reduced environmental impact compared to that produced by the charcoal-based CS_2 process route across all impact categories, namely

1. climate change (39% reduction),
2. human toxicity (23% reduction),
3. terrestrial acidification (12% reduction),
4. freshwater ecotoxicity (32% reduction)
5. fossil fuel depletion (6% reduction).



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1. MSc at UCT
2. Journal of Cleaner Production
3. Presented at SETAC'14 (Society of Environmental Toxicology and Chemistry) , SRCR'14 (Sustainability through Resource Conservation and Recycling) and SAIMM MINPROC '13

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OUTCOMES

- Senmin has successfully implemented a commercially viable first in the world bio polyacrylamide facility
- Senmin has successfully implemented new environmentally friendly technology to produce a strategic raw used in the production xanthate and other speciality collectors, whilst at the same time reducing the dependence on importation of this raw material

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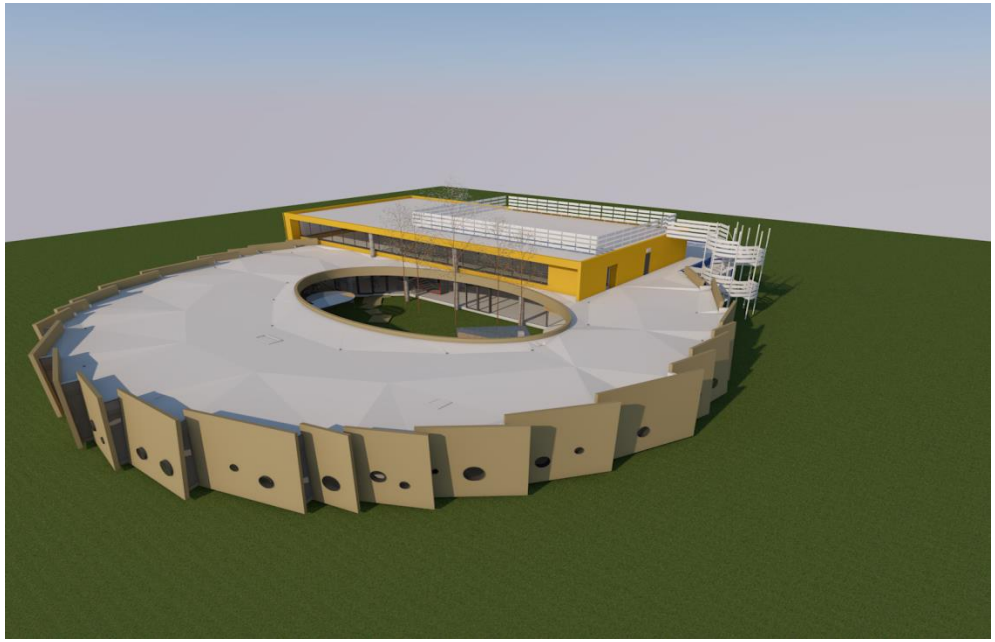
TECHNICAL CENTER

In the quest to grow both our product range and gain a better understanding of the factors that influence reagent performance we have built a Technical Centre in Sasolburg



“Research is to see what everybody else has seen and to think what nobody else has thought”

Nobel Medicine Prize Winner

1937

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