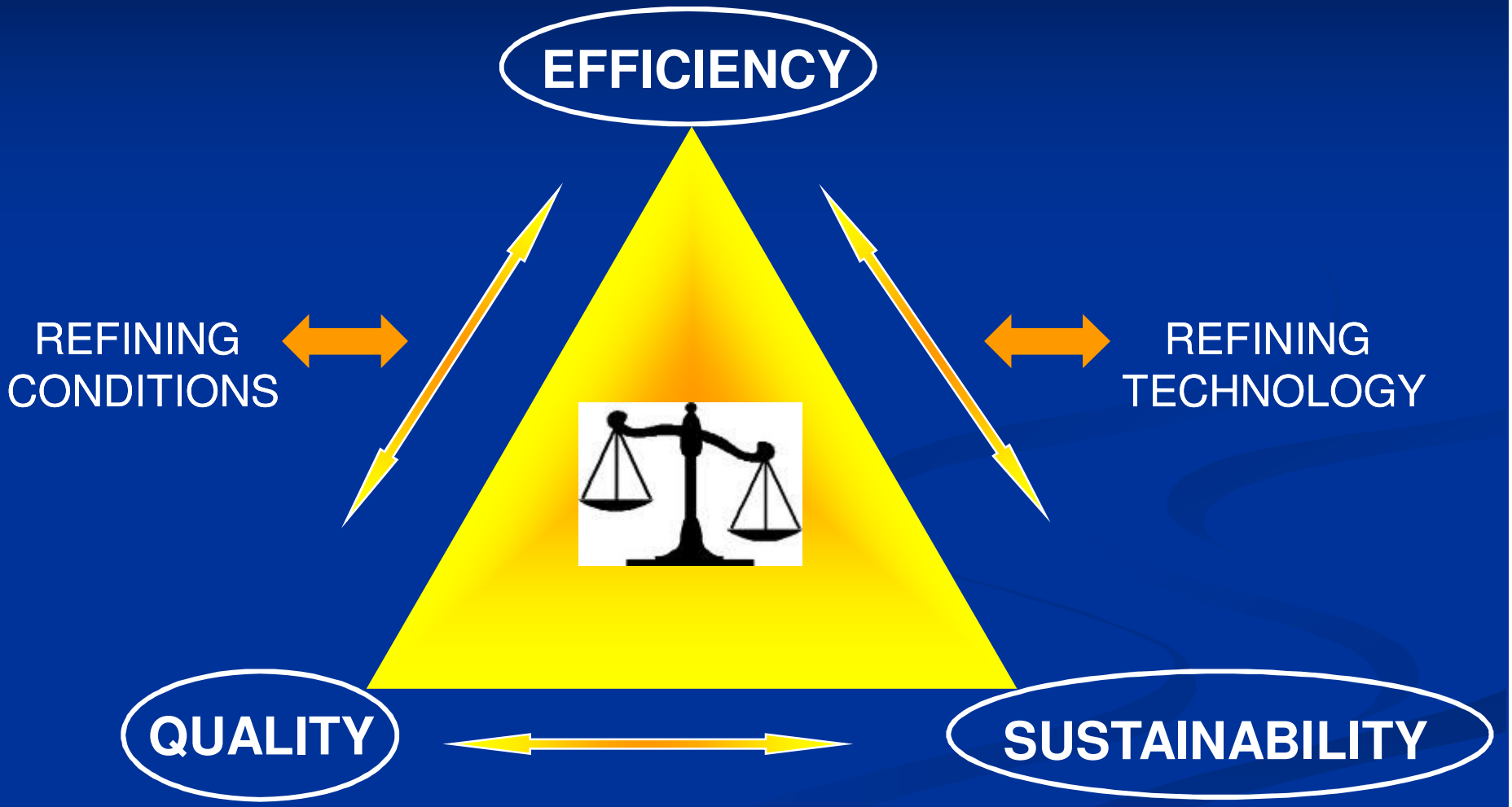
Nano Neutralization™

14th AOCS Latin American Congress

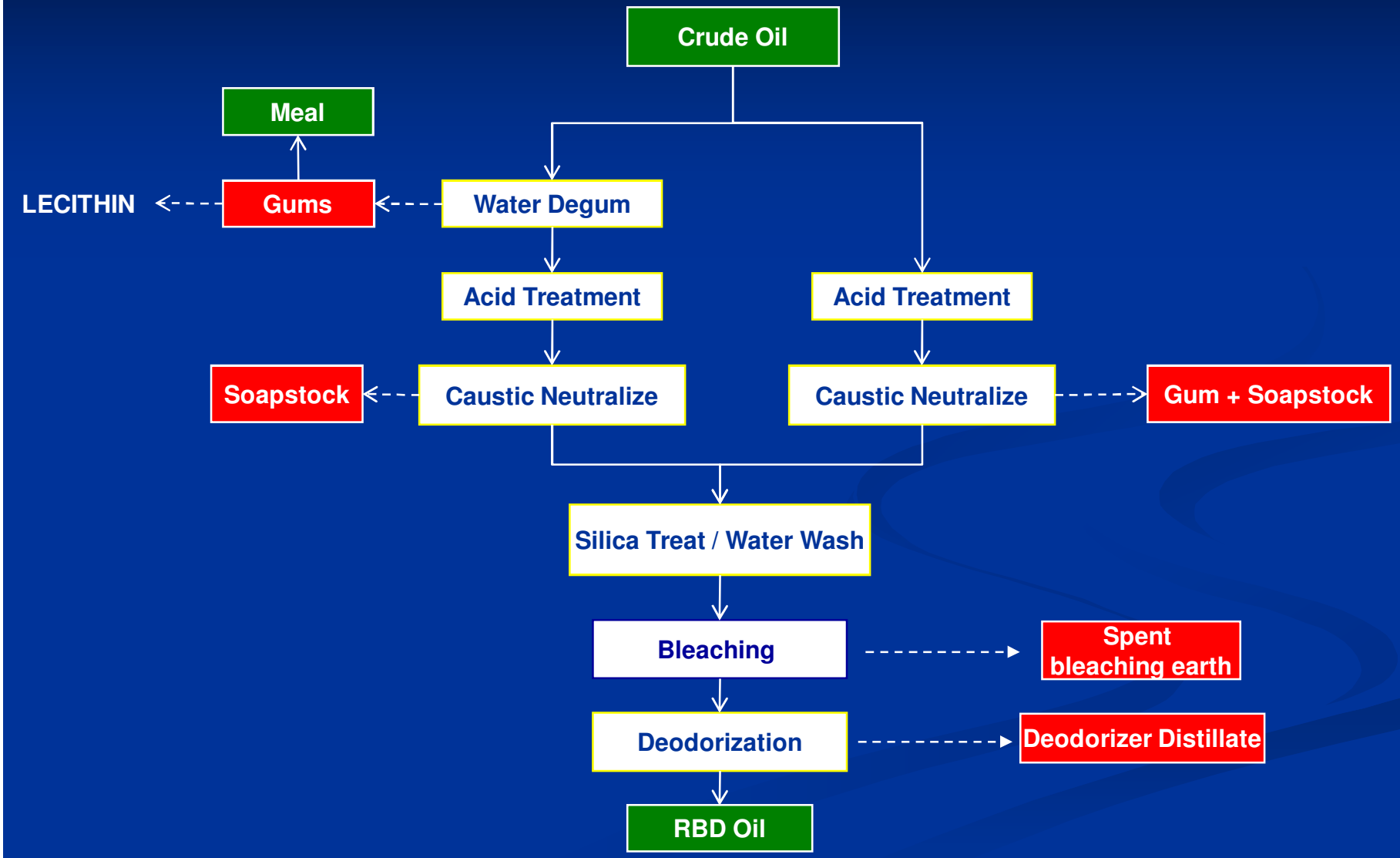
20 Oct 2011

Refiner's Challenge

Unilever's Oil Supply Technology Director Gerrit Van Duijn.



Oil Refining Processes

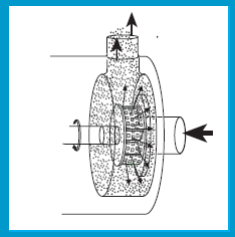


Alkali Neutralisation - Degumming

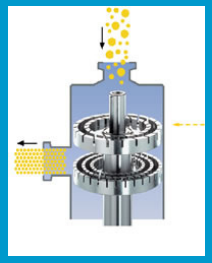
MORE EFFICIENT GUMS/FFA REMOVAL

- Using less chemicals
- Trend towards more intensive mixing

Static → **Dynamic** → **High Shear (single stage)** → **Ultra High Shear (multi-stage)**



Silverson



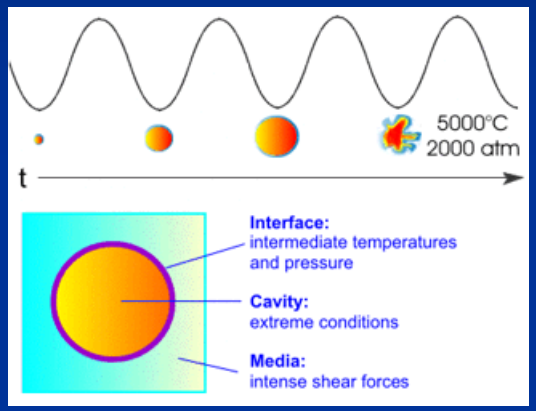
IKA

More intensive mixing requiring higher energy input

How can we improve efficiencies even further?

Acoustic Process

ACOUSTIC PROCESS (SONOCHEMISTRY)



* Generated by Ultrasound waves

*Tested successfully for degumming

Moulton and Mounts (1999)

> 90 % PL removal

*No industrial application due to inherent drawbacks

* Effect depends on distance from source (not uniform)
* Batch process, not suitable for large scale processing
* High energy requirement

Nanotechnology Defined

WIKIPEDIA defines it as:

The study of manipulating matter on an atomic and molecular scale. Generally, nanotechnology deals with structures sized between 1 to 100 nanometer in at least one dimension, and involves developing materials or devices possessing at least one dimension within that size. Quantum mechanical effects are very important at this scale, which is in the quantum realm.

Nanotechnology is very diverse, ranging from extensions of conventional device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nanoscale to investigating whether we can directly control matter on the atomic scale.

Hydrodynamic Nano Reactor®

HYDRODYNAMIC CAVITATION OR NANO REACTOR(R)

* Generated by passage of a liquid through a **constriction**

* Much more energy efficient than acoustic process

* Suitable for larger scale, continuous processes

Typical velocity and pressure profile in a Nano reactor

Nano Reactor®

Nano Reactors(R)

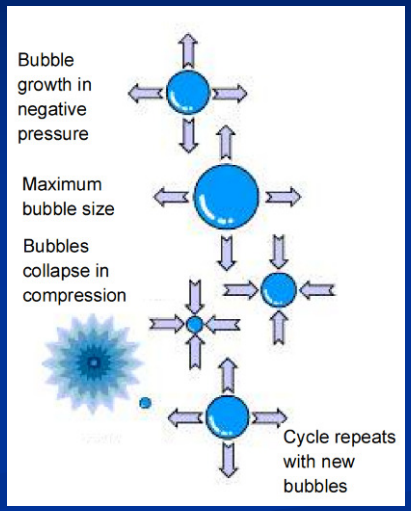
Generation, growth and collapse of bubbles

↓

Release of large magnitudes of energy over small area (high energy density)

↓

Localized very high temperature/pressure with overall ambient conditions



‘Mechanical’ Effects
*High turbulence
*High shear forces
*Fine emulsions

‘Chemical’ Effects
*Fragmenting of molecules
*Formation of radicals

Nano reactor®

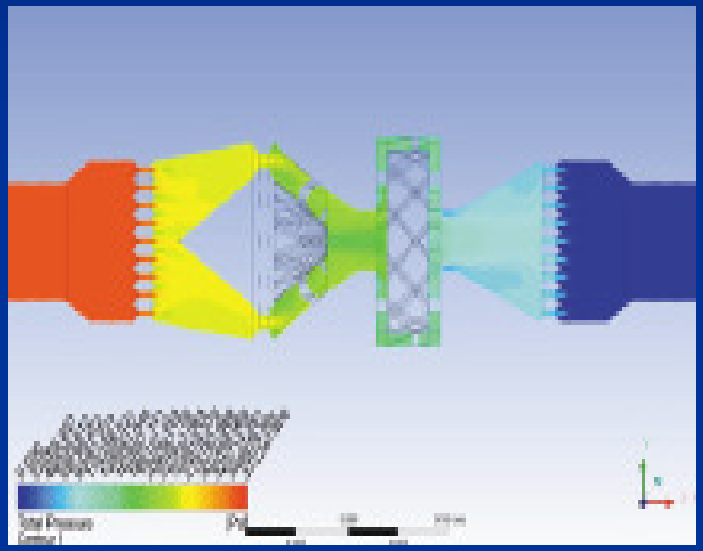
APPLICATIONS OF NANO REACTORS(R)

1. Process intensification (faster-higher yield-more selective)
2. Cell disruption (biotechnology)
3. Microbial disinfection/destruction contaminants
4. Many other specific applications

Can Nano Reactors(R) be applied in Oil Processing

Ref : Gogate – Chemical Engineering and Processing 47 (2008),515-527

Nano Reactor®



Proprietary design of CTI

* Unique internal geometry
* Generation of very small 'nano' bubbles in liquid streams
* Liquids (homogeneous/heterogeneous) are fed to Nano Reactor(R) with high pressure pump
* Mechanical and chemical effects
  - Formation of very fine emulsions
  - Increased surface area
  - Extremely high shear forces
  - Activation of atoms, molecules
  - Formation of radicals
  - Initiation of chemical reactions
* Reactor, more than just a good mixer

Nano-Neutralization™

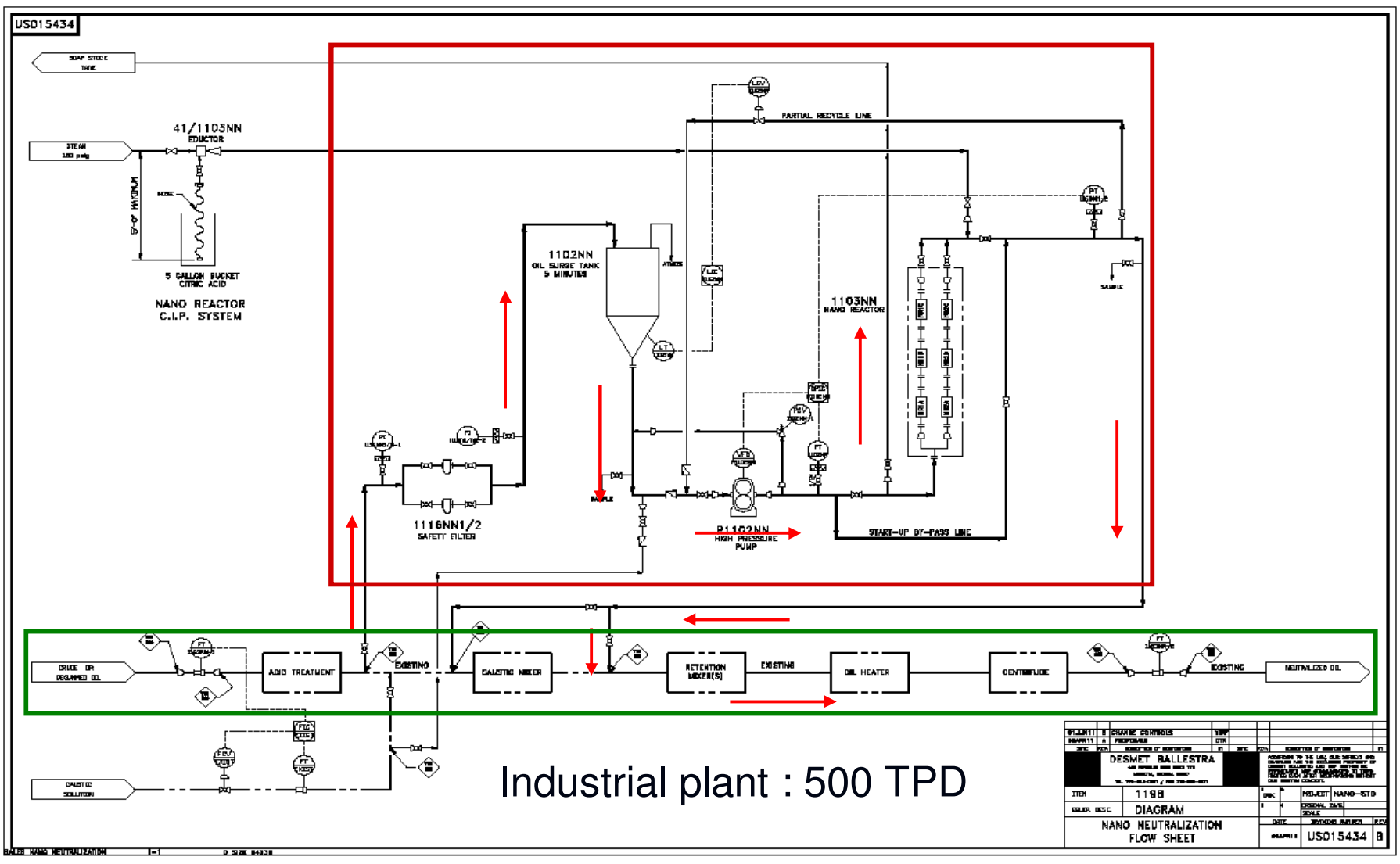
- **Patent pending technology**

- **Add-on process to existing oil refinery neutralisation system**

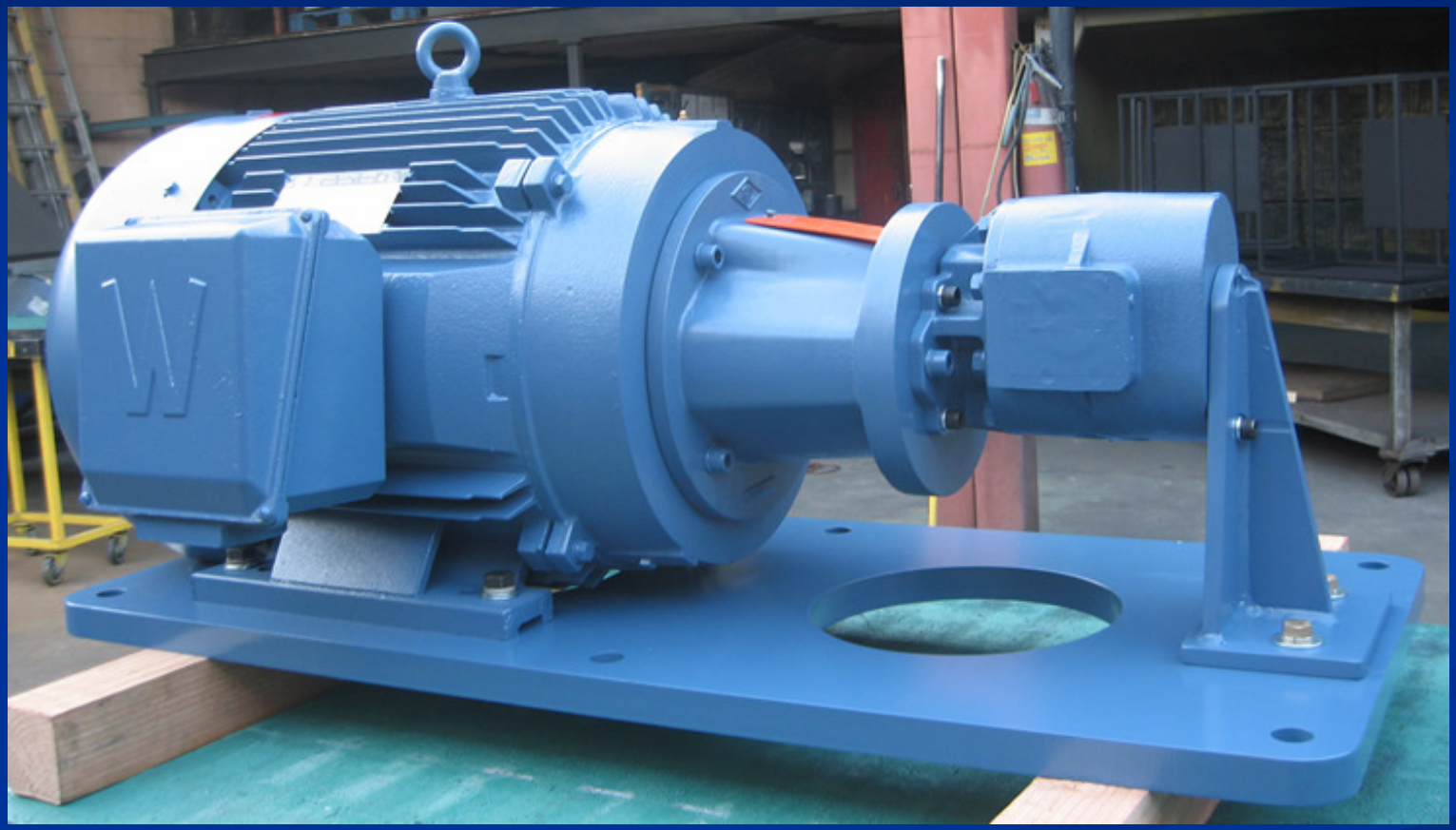
- **Expected Process benefits (industrial proven)**

- **>90% reduction in H_3PO_4 (NHP are made more 'hydratable')**
- **30 – 50% reduction in NaOH (no need for neutralizing H_3PO_4)**
- **Less soaps in nano-neutralized oil reducing need for silica or wash water**
- **Improved oil yield due to improved separation of soapstock (Less neutral oil/minimal salts in soapstock)**

Nano-Neutralization™



Nano-Neutralization™



High Pressure Pump

Nano-Neutralization™

Nano Reactor(R) Assembly

Nano-Neutralization™

500 TPD Nano-neutralisation(TM) of soybean oil

Industrial data

Feedstock	Water-degummed soybean oil (120-170 ppm P; 0.45-0.55% FFA)	
	Nano-neutralization	Classical caustic refining
Process parameters -Phosphoric acid (ppm) -NaOH (% 16.6 °Be) -Pressure (bar) -Temperature (°C)	0-100 0.7 65 50	850-900 1.2
Refined Oil Quality -P-content (ppm) -Ca & Mg (ppm) -FFA (%) -Soaps (ppm)	1-3 < 1 < 0.03 < 100	6-8 < 0.05 200-300

PROJECTED SAVINGS

Feedstock: **Water-degummed soybean oil at 170 ppm P; 0.45% FFA)**

Rate: **40,000 lbs/hr**

	USD / MONTH
0.3 % OIL YIELD IMPROVEMENT:	31,104
SILICA OIL YIELD:	1,866
PHOS ACID:	13,983
SODIUM HYDROXIDE:	4,250
SILICA:	10,575
ELECTRICITY:	(896)
TOTAL:	**61,082**

Nano-Neutralization™

Proven Process Advantages

- 0.2-0.4 % oil yield improvement
- 90% less phosphoric acid
- 30-50% less caustic soda
- less silica consumption

Summary - Conclusions

Efficiency, Quality and Sustainability are key criteria for new/improved processes in edible oil refining

Nano Neutralization(TM) improves:

- Efficiency – less chemicals, higher oil yield
- Quality – lower phospholipids, soap, FFA
- Sustainablility

Thank You For Your Attention

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