

**Introduction to Re-Refined  
Vacuum Tower Asphalt Extenders  
(VTAEs)**



Presented to OHMPA  
2015 Fall Asphalt  
Seminar



Ontario Hot Mix Producers Association

December 02, 2015

# Purpose of Presentation

- Provide a basic understanding of the characteristics of VTAEs
- Where do VTAEs come from
- How are they (or how “should they” be) used

# Agenda

- Oil refining basics
- Crude refinery vs used oil re-refinery
- Statistics
- Discuss future of VTAEs

# VTAEs

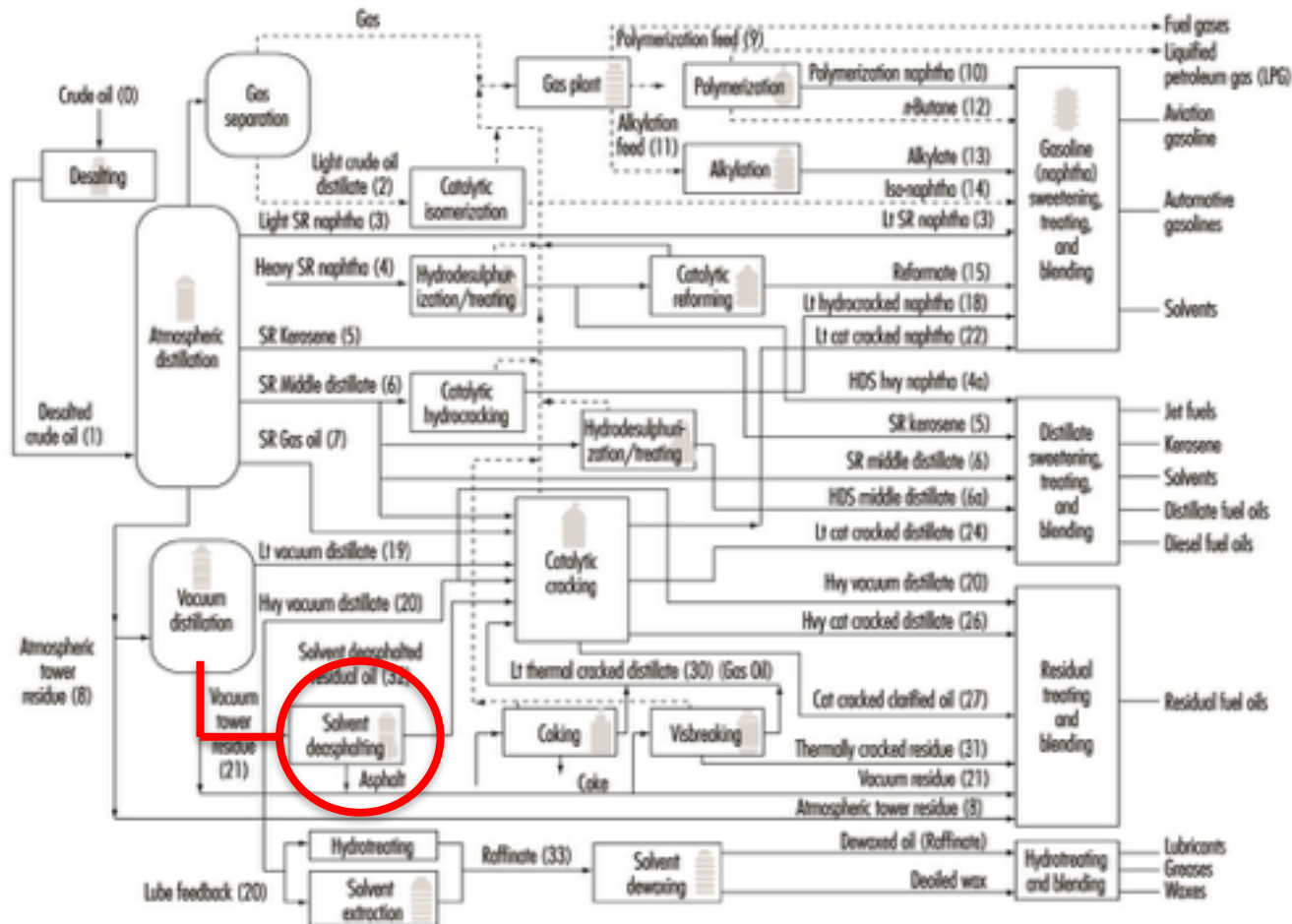
- Also known as...
  - REOB – Re-refined engine oil bottoms
  - RHVTB – Re-refined heavy vacuum tower bottoms
  - RMO – Re-refined motor oil
  - WEO – waste engine oil
  - Others as well...some not so flattering
- **NORA has established VTAE as the standard for our industry**

# The Crude Oil Refinery



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# Simply Put: Asphalt Is A Vacuum Tower Bottom

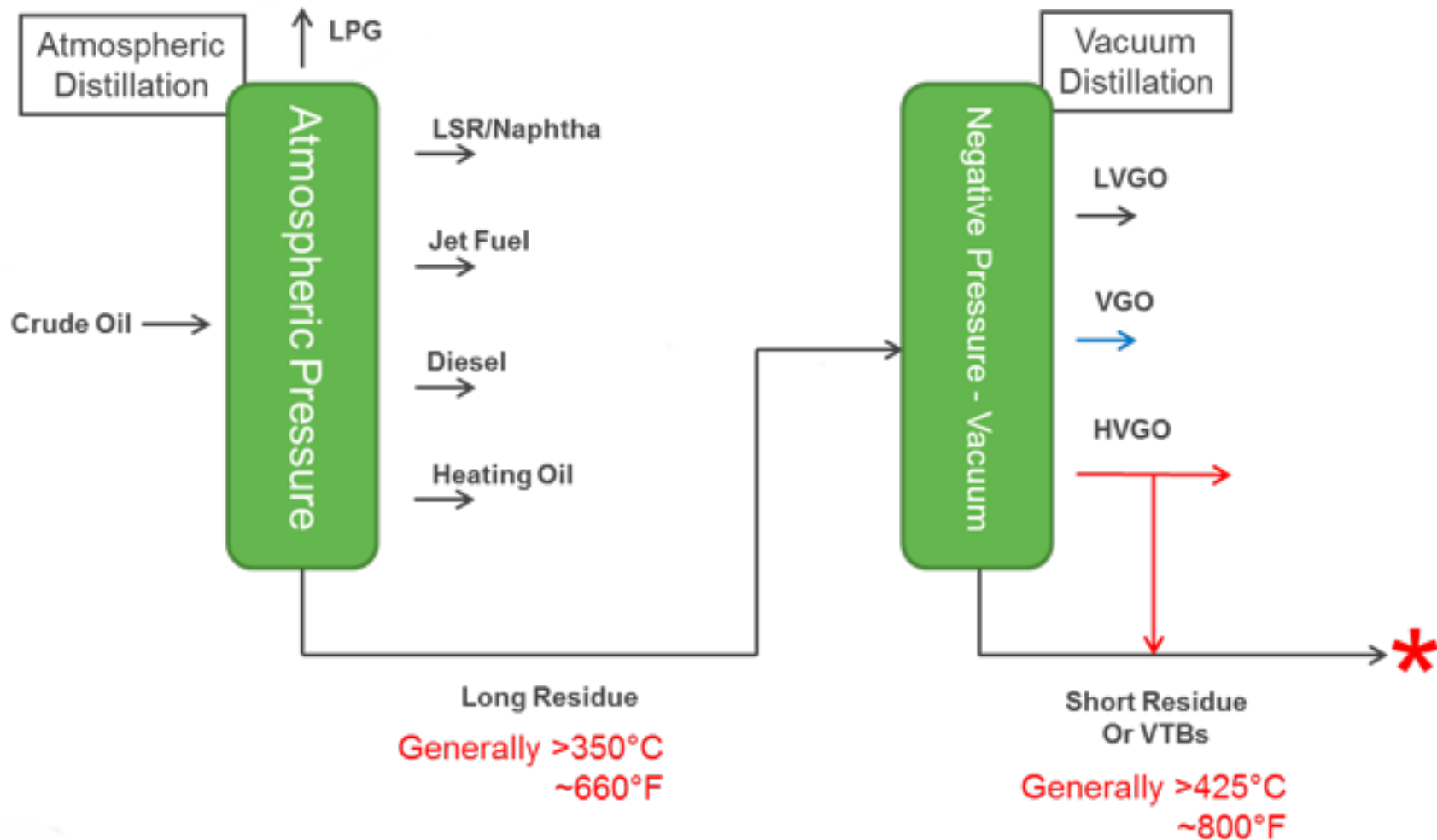


Note: Numbers in parentheses refer to typical product process flow routes.  
Source: OSHA 1996.

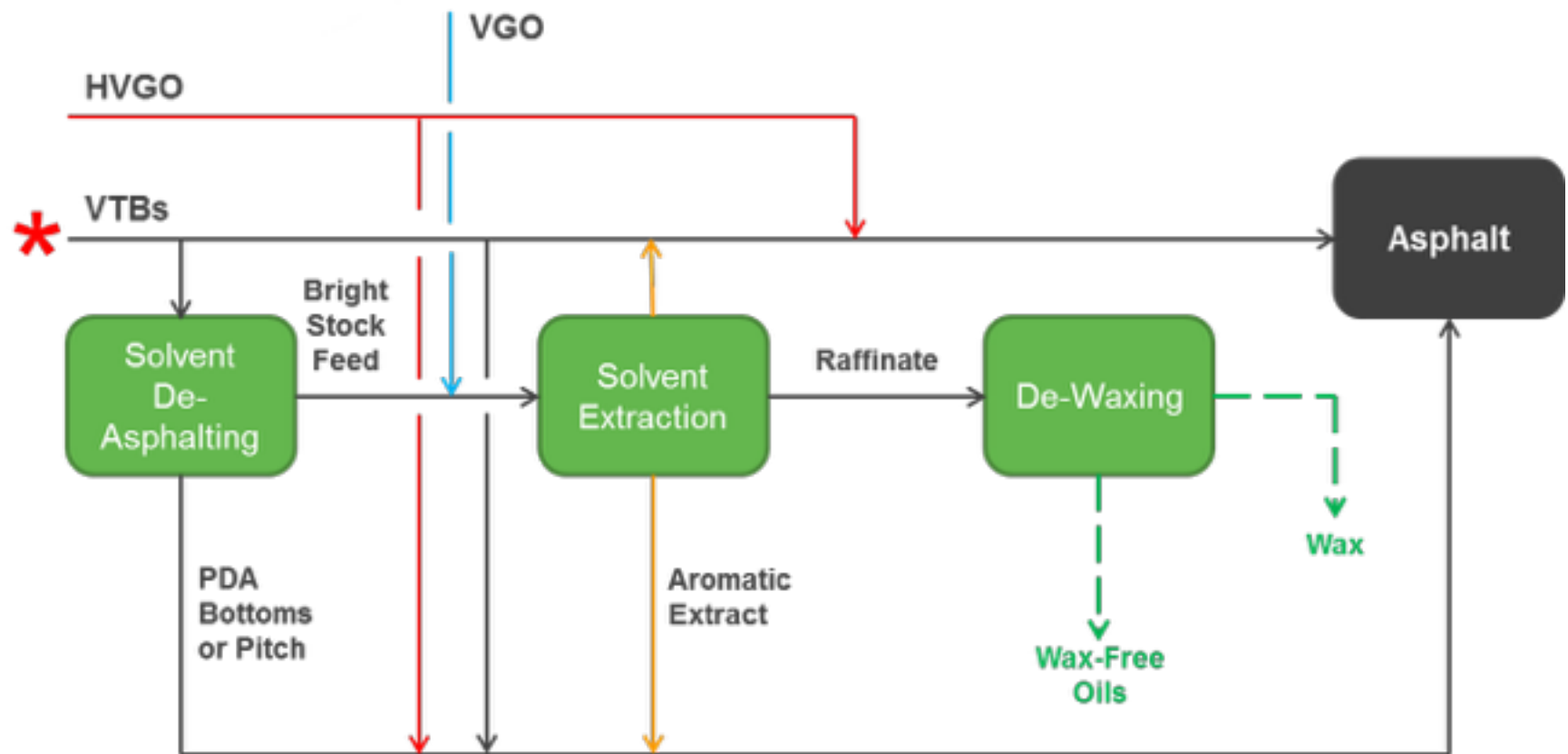
Liquids ————— Gases - - - - -



# Simplified Schematic – Crude Refinery



# Asphalt and Lube Oil Production

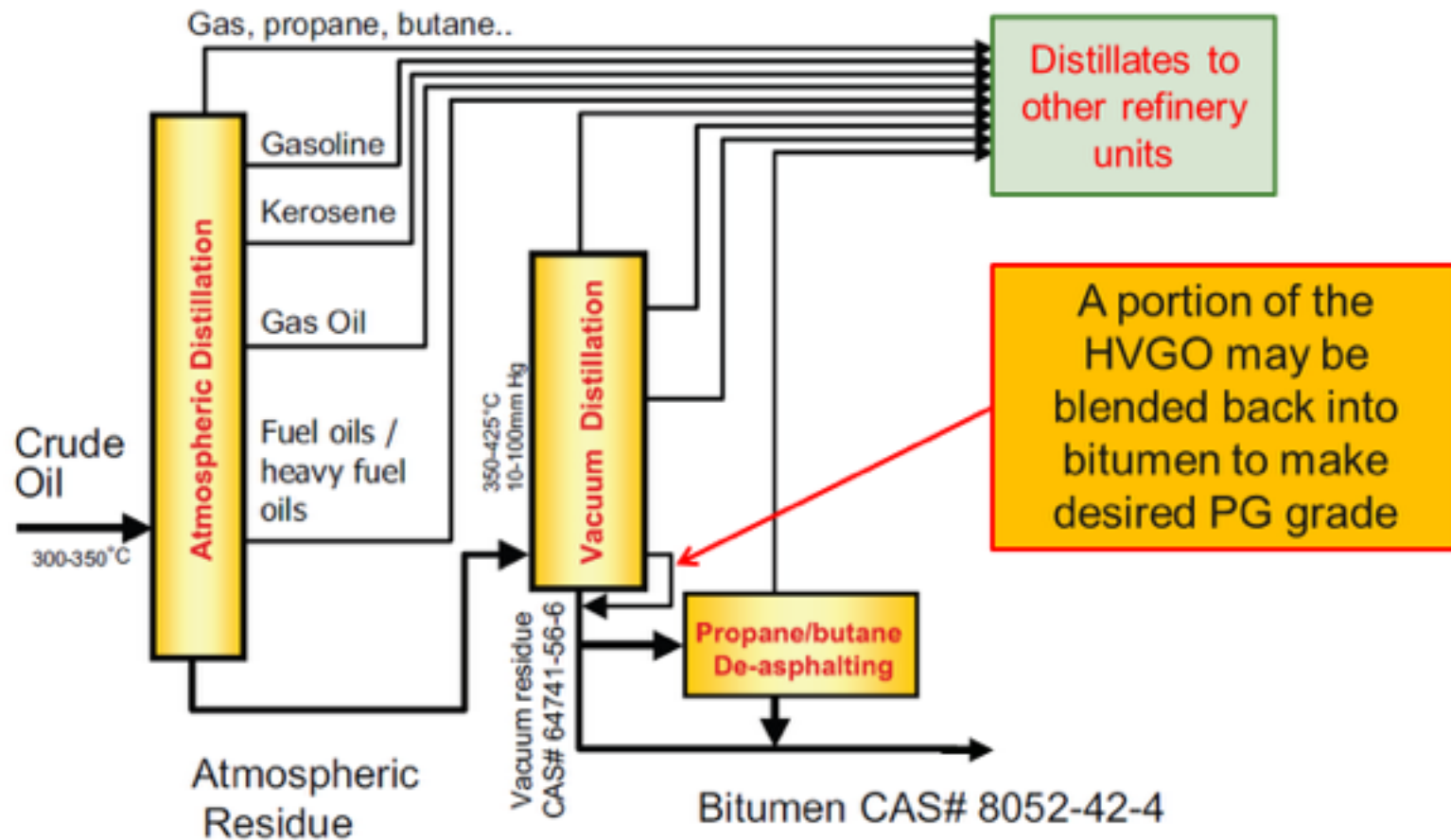




# What Determines Asphalt Grade?

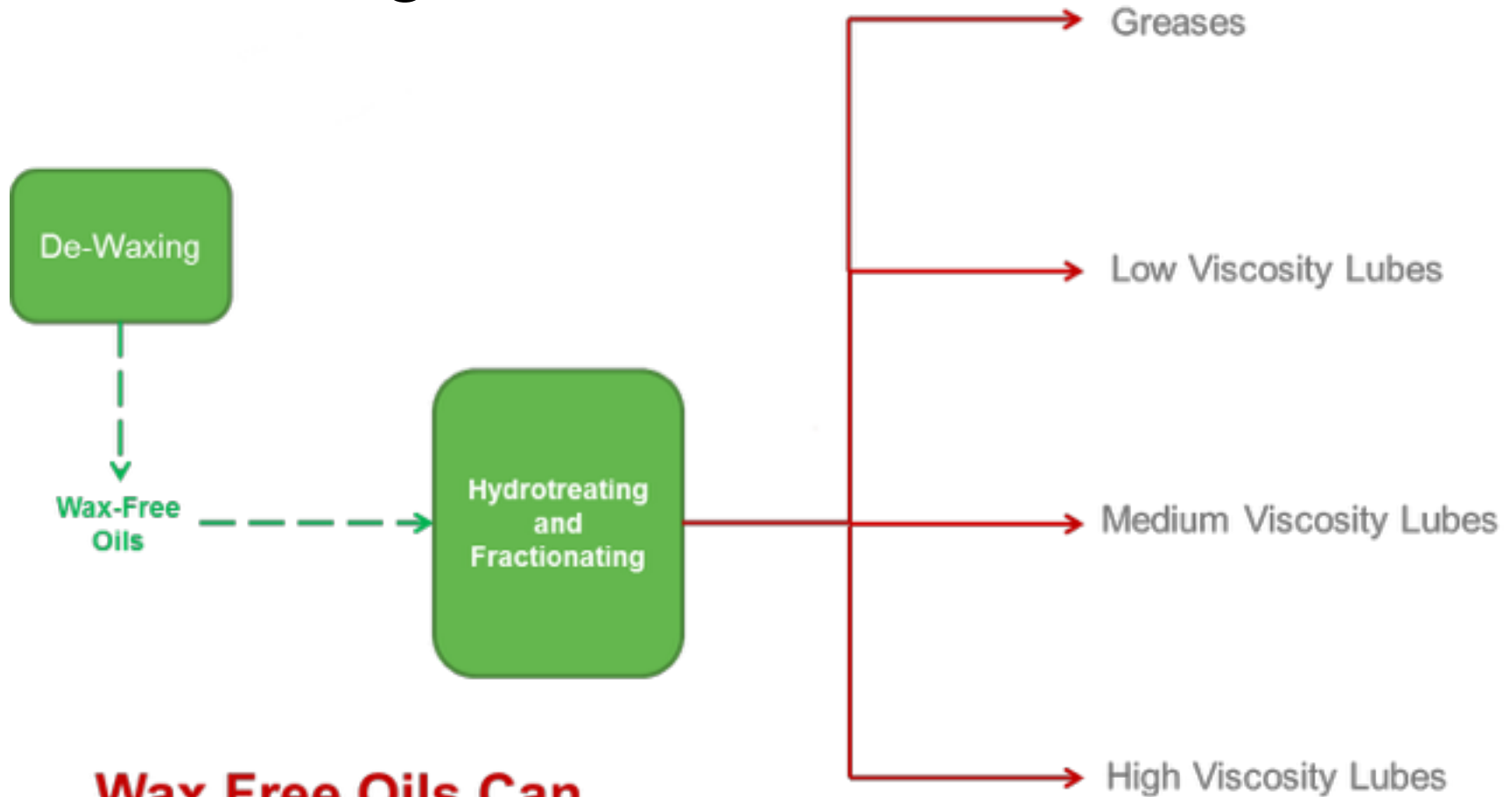
- Crude oil feedstock
  - Heavy Crude: More Asphalt
  - Light Crude: Less Asphalt
- Type of refinery
  - Not all produce the same product slate
- How a given refinery is run
  - Based solely on economics
  - Spread in light vs heavy fraction profitability
  - Asphalt used as Coker feed?
- Lots of blending happens to make asphalt of a given grade

# Distillation Process



Source: Asphalt Institute / Eurobitume "The Bitumen Industry: A Global Perspective," Information Series IS-230, 2011

# Lubricating Oil Production



**Wax Free Oils Can  
Be Further Refined**

# Wax Free Oils

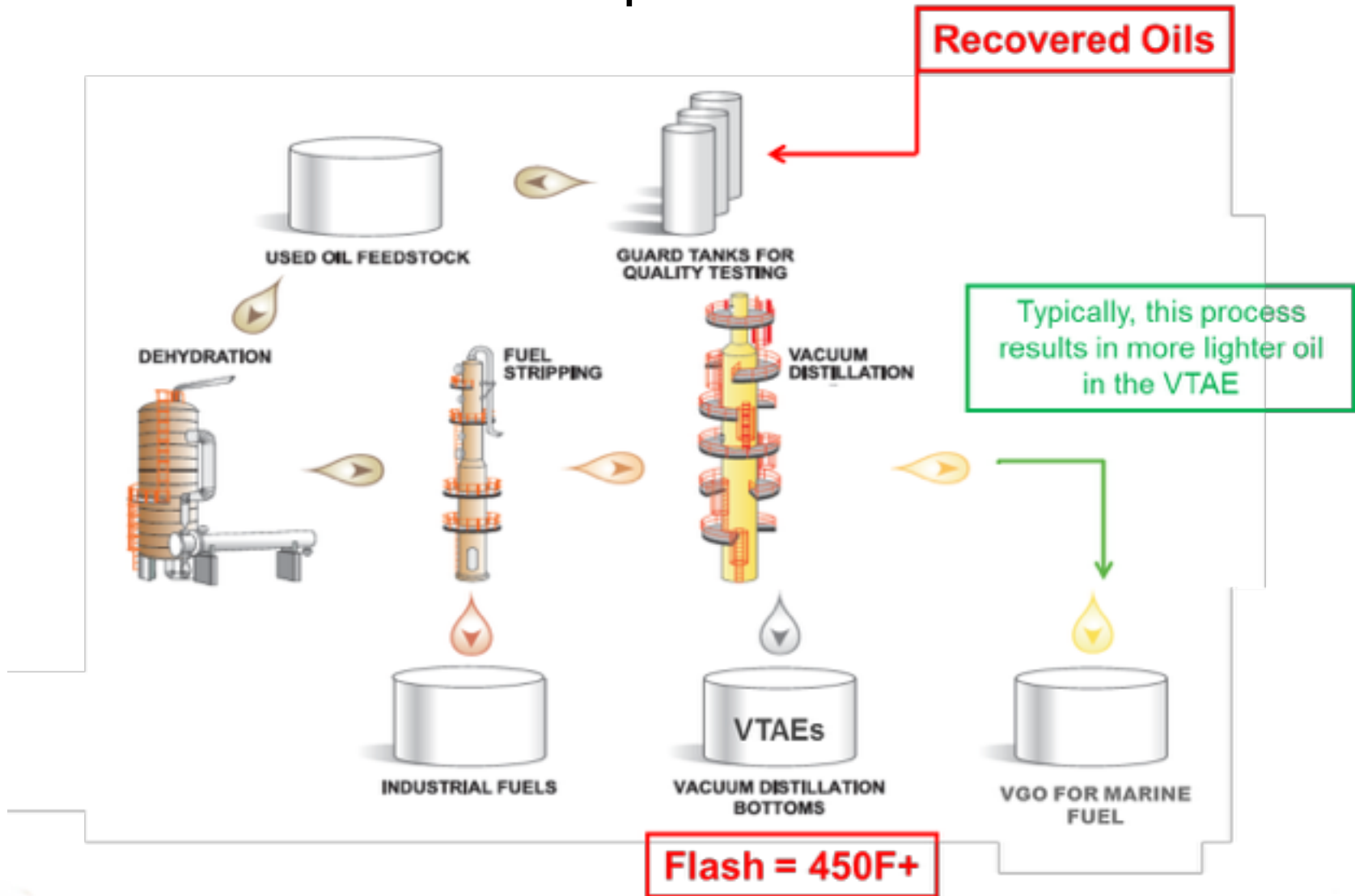
- Additives are used to enhance oil properties
  - Anti-wear additives
  - Friction reducers
  - Antioxidants
- Why do you change your oil?
  - Additives wear out
  - Wear metals from the engine
  - The base oils (wax-free oils) remain mostly unchanged
- We recycle the recovered oils to refine out the “base oils”



# Oil Collection Process

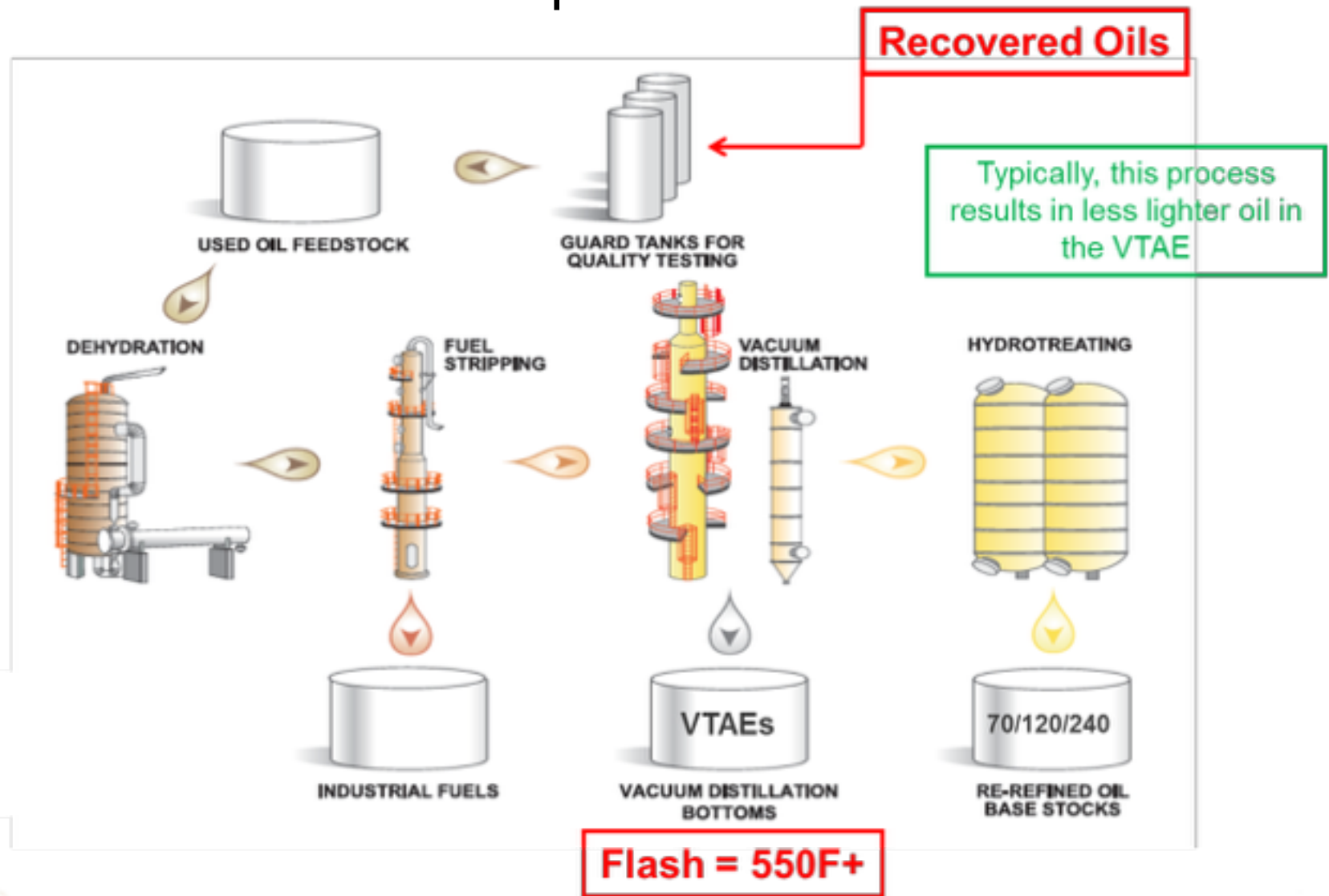
- Oil collectors are required under used oil regulations strictly enforced by EPA to check the oil for contaminants that should not be in the crankcase oil
  - PCB's from old transformers
  - Water
  - Glycols from coolants
  - Chlorinated compounds such as solvents
- The EPA has determined that oil collected in this way is non-hazardous

# VGO Production – Group I VTAEs





# Lube Production – Group II VTAEs

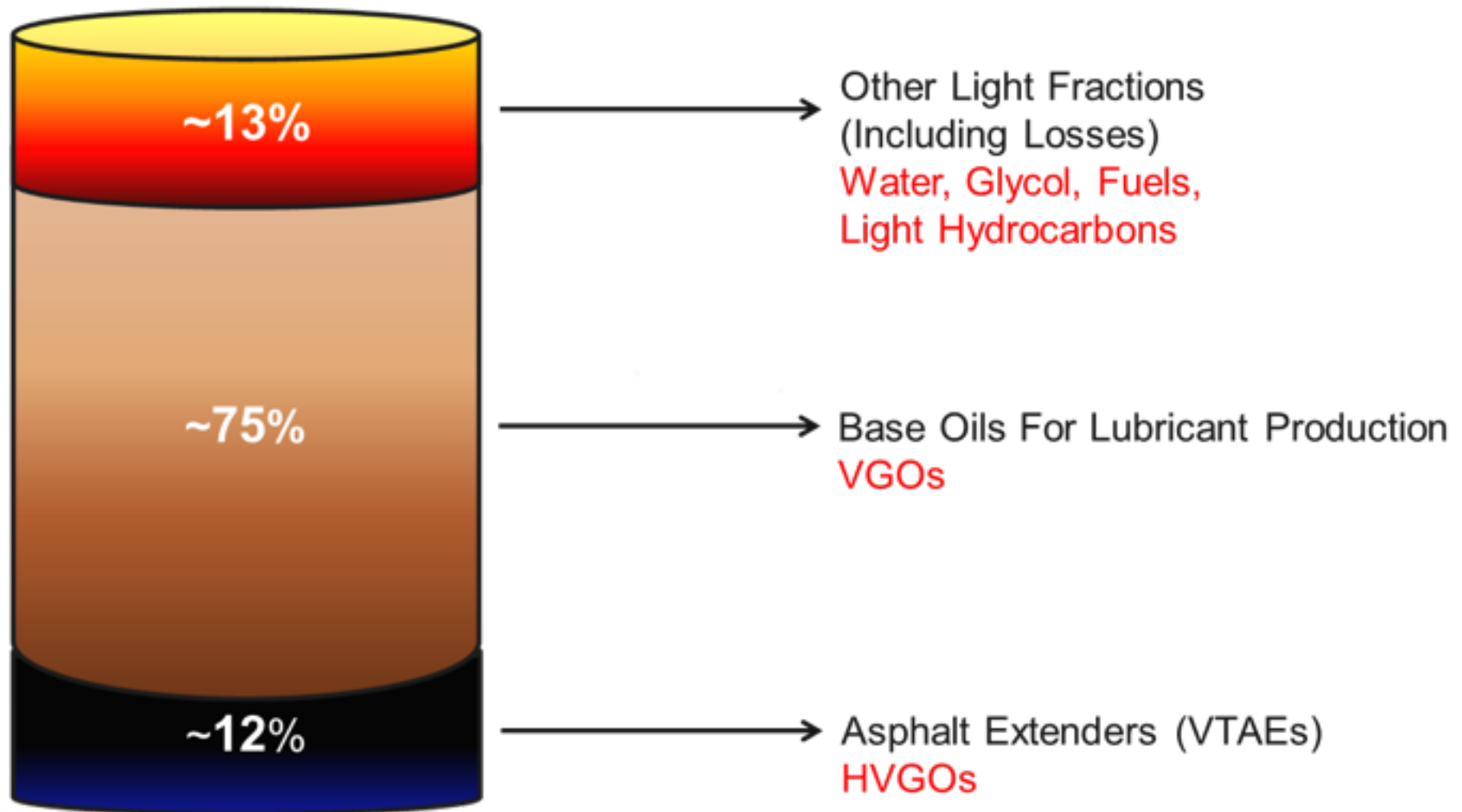


# The Oil Re-Refinery



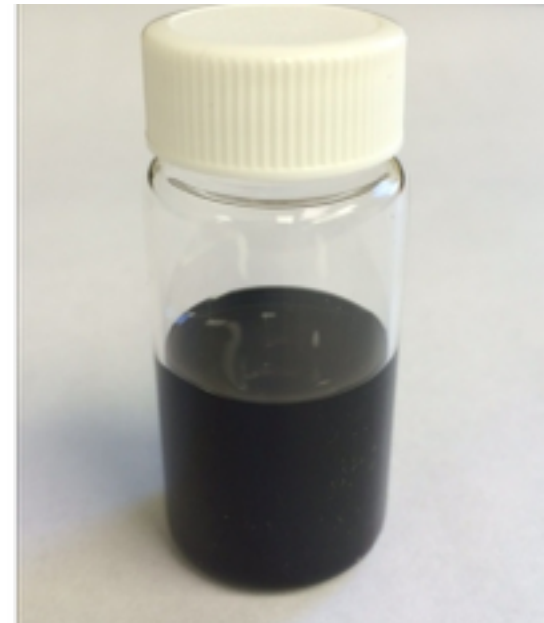
**This is the  
“Real Deal”  
...a true  
refinery!**

# Re-Refined Oils Breakdown



# VTAEs – What is this stuff?

- Definition
  - The non-distilled fraction from the vacuum tower of re-refined lubricating oils



**“Loosely” Equal To AC-1 Viscosity**

# Makeup of VTAEs

- Heavy Vacuum Gas Oils (HVGGOs)
  - Higher viscosity lubricants
  - From industrial lubricants
    - Locomotives, Heavy Trucks, Generators etc.
  - Higher boiling point than base oils for standard motor oils
- Wear metals from engines, gears etc.
- Additives from motor oils
  - Polymers (synthetic oils)
  - Anti-friction additives (molybdenum)
  - Anti-wear (zinc)
  - Viscosity modifiers





# Why Is VTAE Used In Paving Grade Asphalt?

- Used to modify viscosity
  - Crude refiners don't always produce soft asphalt
  - Low viscosity binder reduces cracking potential
- More RAP/RAS requires softer base asphalt
  - Softer binders need to be engineered
  - Hard base asphalt needs to be blended with a cutter



# The Bottom Line

- VTAEs have been used in paving applications for over 30 years in NA as a soft asphalt component to enhance low temperature and aging properties of binders
- Approximately 160KT of VTAEs are produced in NA: that is ~0.5% of total asphalt and less than ~0.4% of the paving asphalt
  - Generally it is used between 2% and 6% by weight of binder making up less than 0.2% by weight of total mix
  - Mix in NA may contain 10-20 times more recycled binder than VTAEs!
  - More recycled asphalt requires softer virgin binder for blending

Total AC in Mix = 5.0%  
30% Recycle replacement = 1.5%  
Virgin Binder = 3.5%  
4% VTAE by weight of Virgin = 0.14%  
 $1.5 / .14 = \sim 11$  times more recycled asphalt

# Myth: Used Engine Oil Is Added Into Asphalt

- Used Engine Oil (UMO) is dehydrated and screened (like crude oil)
- If it is not used as feed for a re-refinery it goes into the marine fuel oil market where it commands **significantly higher price** than wholesale asphalt
- Since it contains fuel (diesel and gasoline) it is combustible and cannot be used in hot mix plants
- Putting UMO into asphalt would be like pouring a heavy crude oil into asphalt
- Used Engine Oil is **NEVER** added to asphalt



# Research

- Little information until ~2009
- This has become a “high interest” issue in recent years
- Much ongoing research now
  - Agencies, Universities, Material Suppliers
- Asphalt Institute formed a task group as part of TAC - 2014

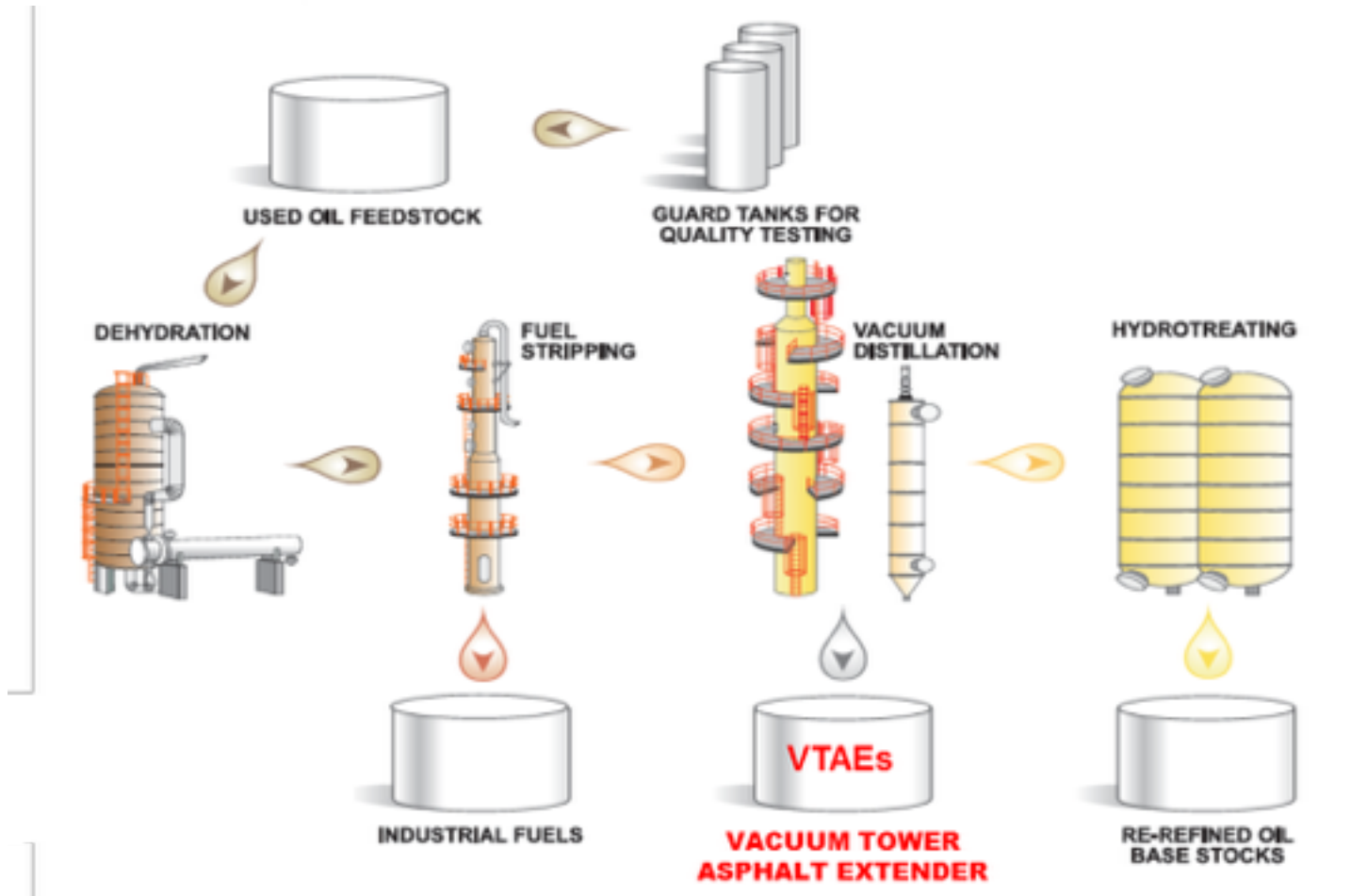
# Asphalt Institute REOB Task Force

- Literature Review Results – 16 total papers published (from FHWA ETG Meeting 09/15 – Buncher)
  - 2 papers looked at waste engine oil (not re-refined)
  - 7 papers suggest the use of REOB is not detrimental and may enhance pavement performance
    - Research by a variety of sources
  - 7 papers suggest the use of REOB is detrimental to pavement performance
    - All 7 traceable to Hesp et al

# Use In Paving Binders

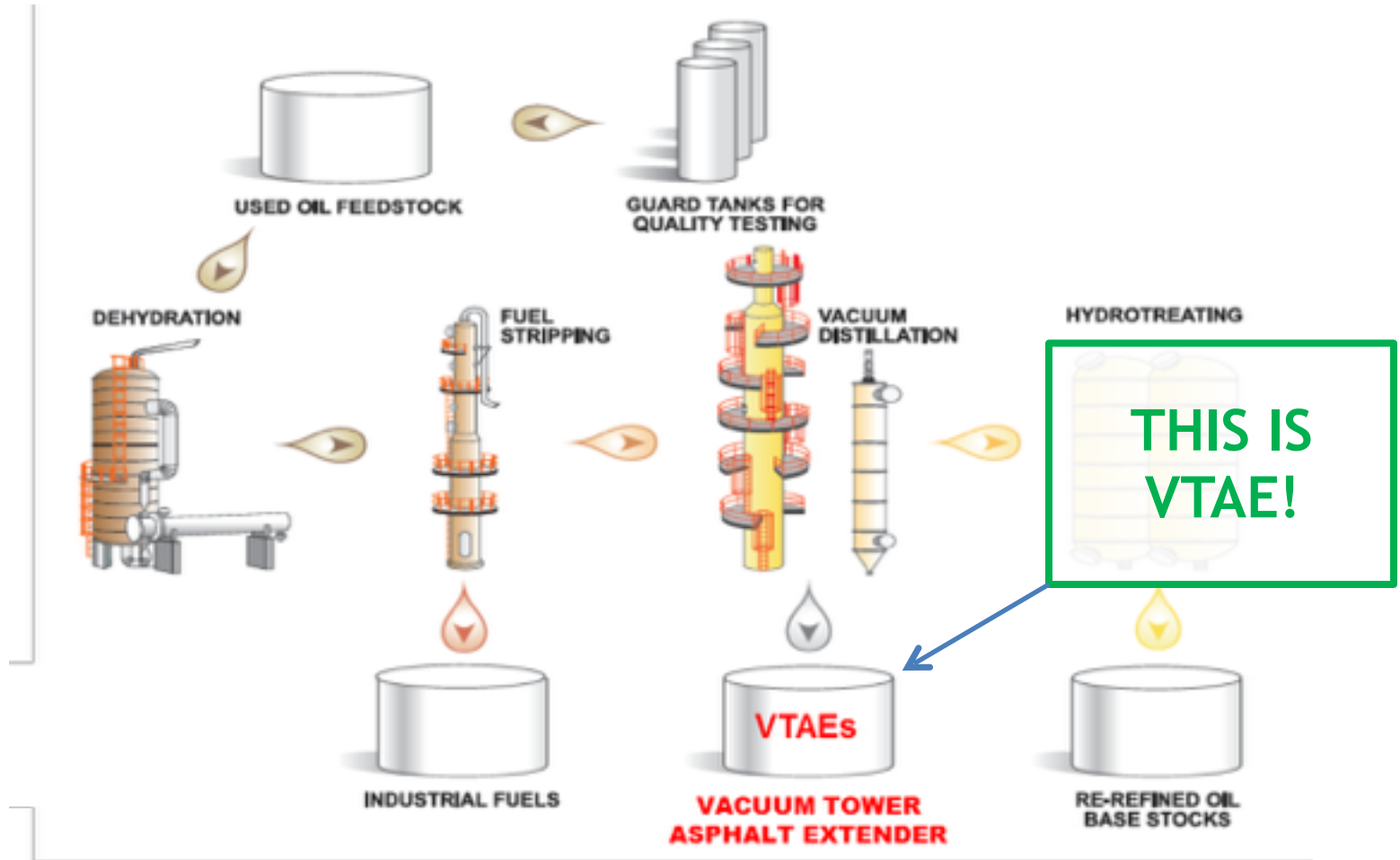
- **Benefits** (Dosage Dependent and when used properly)
  - Improve Cold Temperature Properties
    - PG (PAV Properties)
  - Reduce Viscosity
  - Improves Resistance to Aging
  - Extends Conventional Asphalt
  - Reduces Carbon Footprint
  - Compatible with Nearly All Asphalts
  - Long History of Use

# This Process defines VTAEs

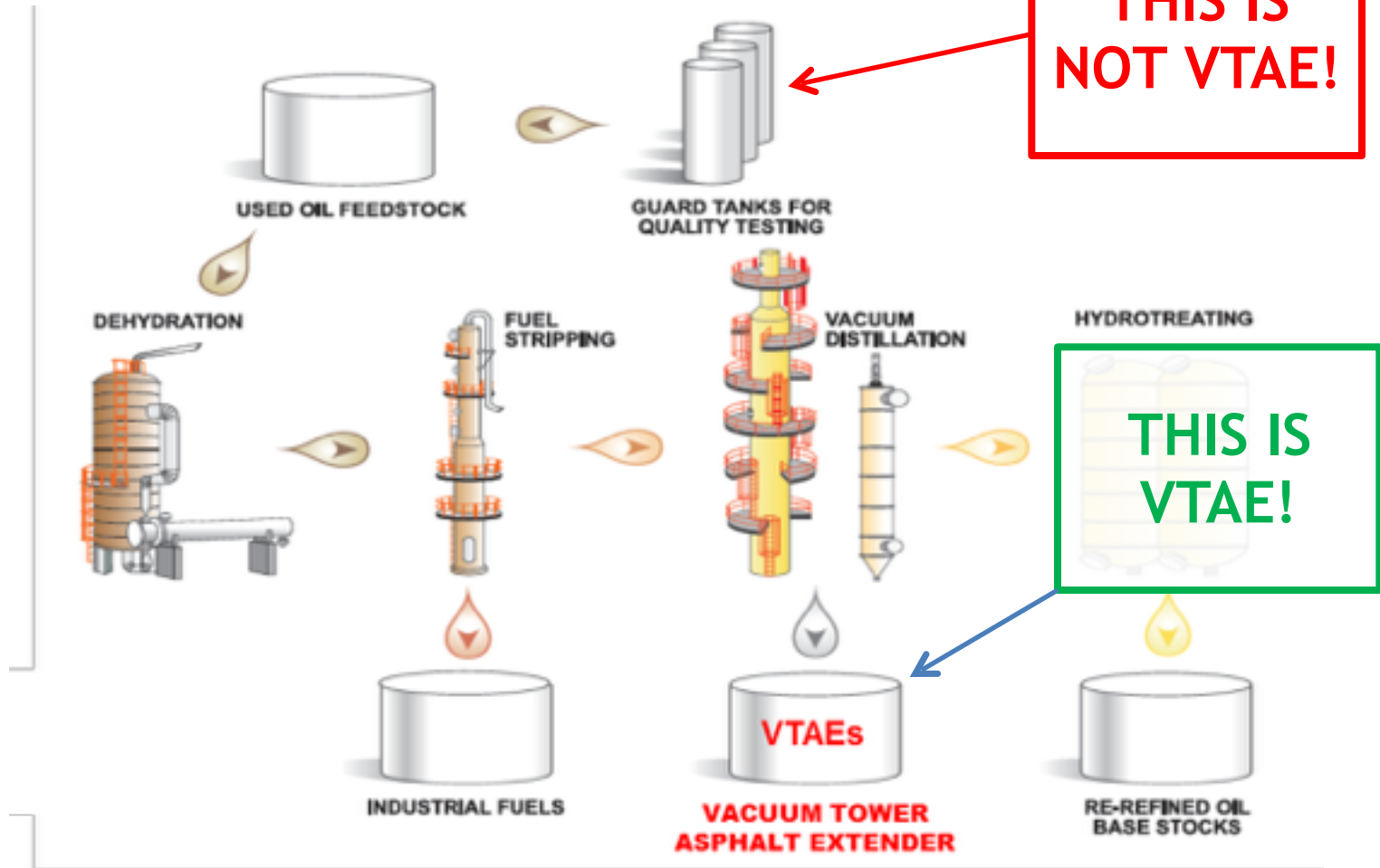




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THANK YOU!

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