Engineering Consulting & Training Services

CARMAGEN Engineering, Inc.

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Logistical Forensics

By Winston K. Robbins, Ph.D.

Logistics, the flow of petroleum crude movements and product distribution, plays a major role in refinery operations. Logistical problems cause refiners' nightmares. If precipitates overwhelm desalters, then flows may need to be reduced in the entire refinery. If a process stream is contaminated, then blended products may be off spec. If a delivered product is unacceptable to customers, then entire distribution systems may get backed up. Because any of these problems may be related to contamination or process failures, they may be subject to litigation. In such cases, determination of responsibility falls to "logistical forensics."

Forensics, more properly forensic science, is the application of a broad spectrum of sciences to answer questions of interest to the legal system. For refiners with potential legal logistical problems, forensics is often carried out by consultants working under the direction of third party lawyers. Consultants working in this role may ultimately testify as expert witnesses, but more importantly, they bring experience and technical knowledge to bear on evaluating the logistical problem. This requires that forensic consultants possess a unique combination of skills that allow an unbiased determination of the nature of each problem.

First, the forensic consultant works for third party attorneys. All work must be carried out within a legal context ("attorney work product") that may be subject to discovery. This necessitates that all retained communications be clear and concise: clear to assist attorneys in understanding the technical issues that they may have to present to a judge or jury; concise to deal with facts not opinions.

Second, the forensic consultant works with the refining company. The consultant is brought in to deal with a problem because the logistics have reached a level of management that is facing a logistical deadline, excessive costs, or potential refinery shutdown. At this level, a meeting on a logistics issue may include managers from marketing, distribution, operations, supply, product quality, and safety. The consultant must be able to communicate key logistics-related technical issues to a petroleum savvy audience with different agendas.

Third, the forensic consultant works with the refinery. Local engineers have most likely carried out some type of "root cause analysis," which suggested that litigation may be imminent and therefore requested the attorney involvement. However, the consultant is an outsider. As a technical expert, he or she brings "fresh eyes" to the problem. This requires a delicate balance between challenging the assumptions used locally and introducing new "foreign" concepts. Although a consultant may have more experience and a deeper theoretical understanding of a problem, local knowledge and history are equally valuable in identifying deviations from the norm.

Upcoming Training Course held in our NJ offices

- Course 1302, *Relief System Design,* June 21-23, 2011

For more information, see our website at www.carmagen.com.

Work Highlights

Process, Operations, & Safety

Assisted a client with timely development of licensed refining unit process package documentation in the foreign language of their overseas owner.

Providing consultation to an overseas client with study update, and ultimately with selected support on the FEED work and implementation of a new stand-alone FCC power recovery / flue gas expander train with ancillary facilities.

Providing safety and process operations technical expert litigation support on a case involving an engineering company, licensor, and personnel connected in a refinery incident.

The forensic consultant evaluates the problem on the basis of hard data. The primary role of the consultant is to identify the contributing factors to a logistical roadblock. That may require reviewing proprietary process diagrams, extracting details from unit run sheets, digging out compositional data from analytical log books, or evaluating the quality of supply delivery. On the other hand, based on theoretical knowledge of potential sources of difficulty, the consultant may suggest the collection of additional analytical data (locally or from outside sources) and even design and coordinate lab experiments to test hypotheses.

Above all, the consultant is hired to help eliminate the logistical block. If the problem is internal, then the consultant should point the refiner to a path to eliminate the problem. If the problem is external (i.e., the responsibility resides with a third party), then the consultant should prepare an affidavit to that effect for the attorneys and be available to serve as an expert witness, if called.

The examples mentioned at the outset illustrate the effectiveness of a forensic consultant.

- A refiner was encountering desalter plugging.
  - The refiner was found to be blending two incompatible crudes: one crude generated excessive H_2S when heated in the preheat furnace while the second had a high concentration of calcium naphthenate. When combined, copious volumes of insoluble CaS were formed.
    - ~ Solution: avoid this blend
- A refinery side-stream was found to be contaminated with phosphoric acid.
  - Phosphorous, but not phosphoric acid, was determined to be introduced periodically in crude blends.
  - This was traced back to a specific field where a kerosene recovered from oil-field stimulation was being added back into the crude. The stimulant contained a thermally unstable phosphorus rich additive.
    - ~ Solution: litigation, changed practices, changed stimulant additive
- Distributed product passed initial product quality testing but gave unacceptable results when distributed.
  - Theoretical evaluation suggests composition leads to non-polar hydroperoxide formation during storage (Figure 1).
  - Adsorbent treating ineffective in removing hydroperoxides.
  - Upon heating, hydroperoxide initiates chain reactions that form color bodies and deposits.
    - ~ Solution: inert distribution system to avoid hydroperoxide formation

In each logistical case, forensic principles were applied successfully and problems solved to the satisfaction of attorneys and refiners.

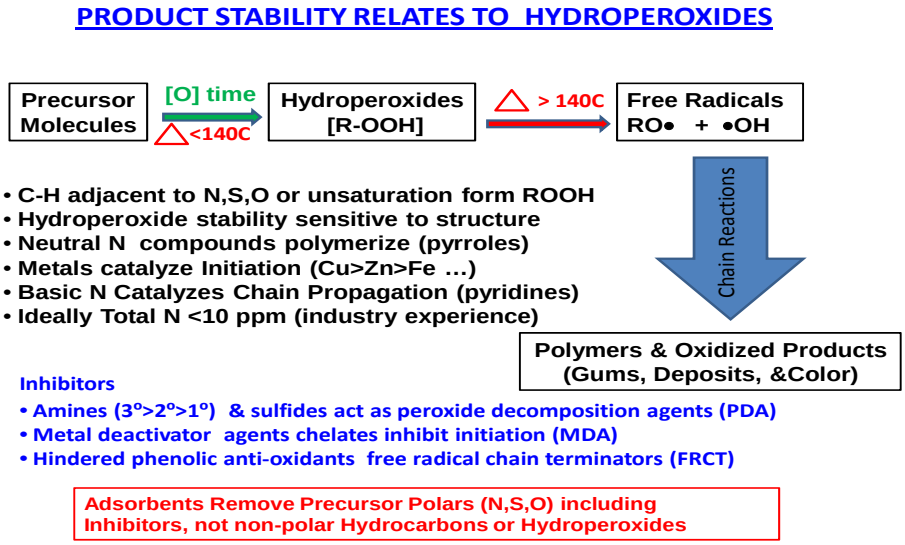

Figure 1. Forensic Factors in Color Body/Deposit Problems

About the Author

Win Robbins has extensive analytical expertise in the areas of reactive sulfur/naphthenic acids characterization, HPLC-2 ring type definition technology, and polynuclear aromatic hydrocarbons (PNA) characterization.

Please contact Jerry Lacatena (jlacatena@carmagen.com) if you'd like more information on Carmagen's expertise in this area.