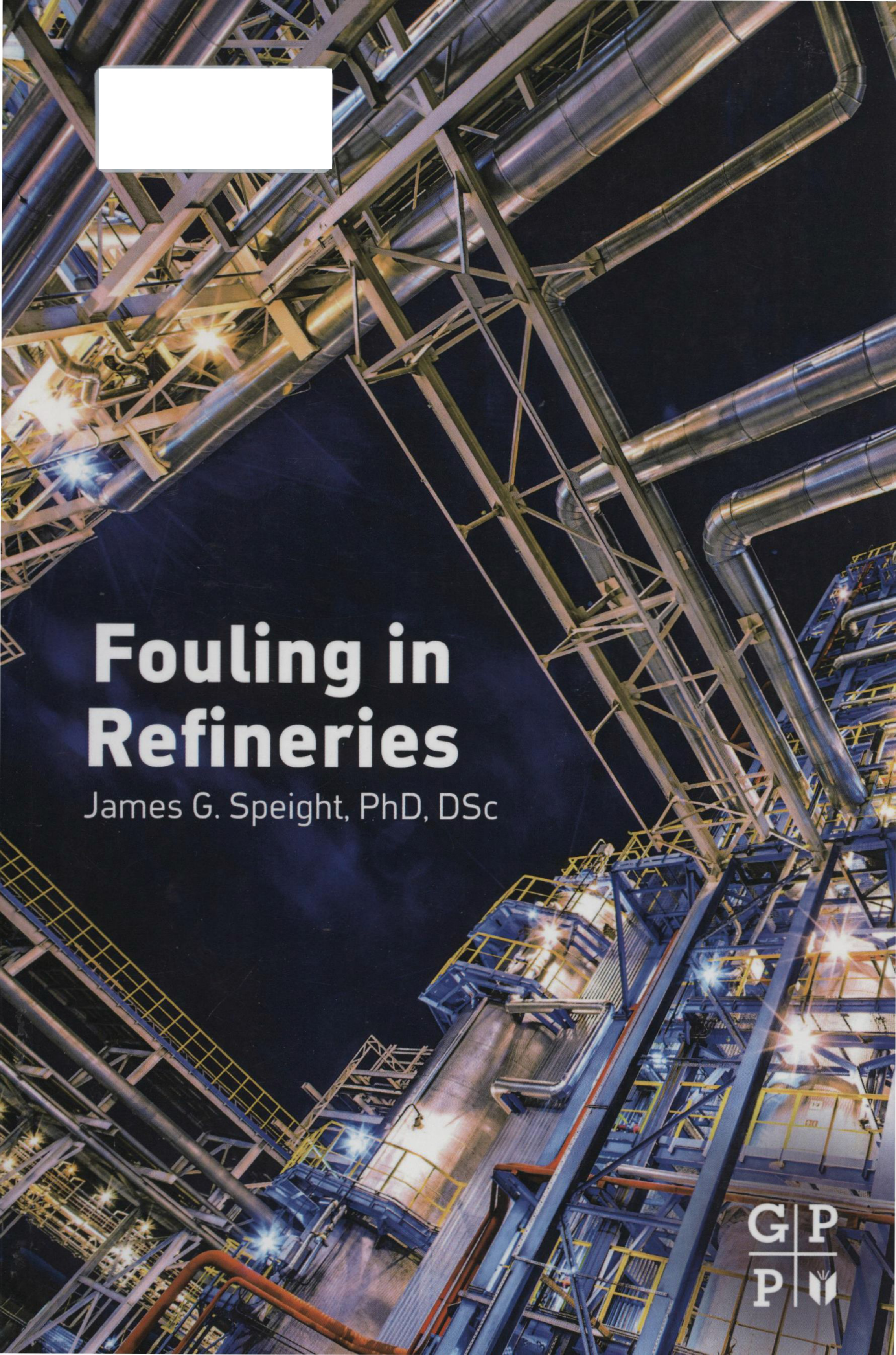

Fouling in Refineries

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By

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Fouling in Refineries

Preface

Fouling (solids deposition and phase separation) can occur throughout the refinery and can affect almost every unit. Initially, fouling impacts mostly on the crude unit and other units where the whole crude is the feedstock. These units experience the highest feed rates and temperature increases. The battle to maintain heat through the preheat network of exchangers and furnace inlet temperatures is a constant issue. Traditionally (in the refining sense), the fouling is caused by the instability of asphaltene constituents, which can manifest itself as early as the tank farm through incompatible crude storage. In the refinery, exposure of the asphaltene constituents to heat changes the stability of the asphaltene constituents leading to agglomeration and deposition. Broadly, this can result in flow restrictions and harder furnace firing rates (more refinery fuel gas is consumed) in order to maintain temperatures at the distillation column or to reduce the crude throughput. In addition, nonasphaltene products formed during thermal processes can also give rise to phase separation and fouling.

In addition to fouling caused by the presence of asphaltene constituents, the wax constituents of crude oil (and crude oil products) are also capable of contributing the fouling. The presence of the constituents of wax increases fluid viscosity and its accumulation on the walls reduces the flow line section, causing the blockage of filters, valves and even pipelines, increasing pumping costs, and reducing or even having an adverse effect on crude oil production, storage, and transport. Thus, constituents of wax present in petroleum mixtures—as well as in petroleum products—can separate and form a precipitate when the temperature decreases during oil production, storage, and transport.

More specifically, wax may be deposited on the components of the production system by various mechanisms and causes loss of production, reduced pipe diameter, and increased horsepower requirements, and negatively impacts production economics. The available remedial measures include mechanical, chemical, and thermal techniques. Temperature reduction/heat loss is a dominant factor in wax problems, as wax begins to precipitate from crude when the temperature falls to or below the cloud point (wax appearance temperature). However, other factors such as pressure, oil composition, gas-oil ratio, water-oil ratio, flow rate, well completion, and pipe-surface roughness also contribute to the problem of wax deposition.

Over time, fouling (whatever the cause—asphaltene constituents or wax constituents—leads to higher energy consumption, higher maintenance costs, reduced feed rates, and shorter intervals between turnaround. This can result in severe economic penalties, as well as significant safety and environmental concerns.

This book covers the various aspects of fouling during production and in refinery units and describes how the fouling rate can be greatly influenced by the crude type or blend as well as the effects of using opportunity and high acid crudes, although these crude do offer an economic incentive to the refinery that can process them. The book will also assist the reader to develop an analysis-based strategy to operate production and refining equipment below the threshold fouling conditions as well as create a knowledge-based system for understanding and predicting the potential of crude oil to contribute to the fouling phenomenon.

The book will be valuable to production personnel, pipeline personnel, and refinery personnel—researchers, process engineers, process chemists, and managers—as well as to nonrefinery personnel—analysts and researchers—who need to understand the chemical and physical mechanisms of fouling.

Dr. James G. Speight
Laramie, WY, USA

Biography

Dr. James G. Speight, who has doctorate degrees in Chemistry, Geological Sciences, and Petroleum Engineering, is the author of more than 60 books in petroleum science, petroleum engineering, and environmental sciences. He has served as Adjunct Professor in the Department of Chemical and Fuels Engineering at the University of Utah and in the Departments of Chemistry and Chemical and Petroleum Engineering at the University of Wyoming. In addition he has been a Visiting Professor in Chemical Engineering at the following universities: the University of Missouri-Columbia, the Technical University of Denmark, and the University of Trinidad and Tobago.

As a result of his work, Dr. Speight has been honored as the recipient of the following awards:

- Diploma of Honor, United States National Petroleum Engineering Society. *For Outstanding Contributions to the Petroleum Industry*. 1995.
- Gold Medal of the Russian Academy of Sciences. *For Outstanding Work in the Area of Petroleum Science*. 1996.
- Einstein Medal of the Russian Academy of Sciences. *In recognition of Outstanding Contributions and Service in the field of Geologic Sciences*. 2001.
- Gold Medal—Scientists without Frontiers, Russian Academy of Sciences. *In recognition of His Continuous Encouragement of Scientists to Work Together across International Borders*. 2005.
- Methanex Distinguished Professor, University of Trinidad and Tobago. *In Recognition of Excellence in Research*. 2006.
- Gold Medal—Giants of Science and Engineering, Russian Academy of Sciences. *In recognition of Continued Excellence in Science and Engineering*. 2006.

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