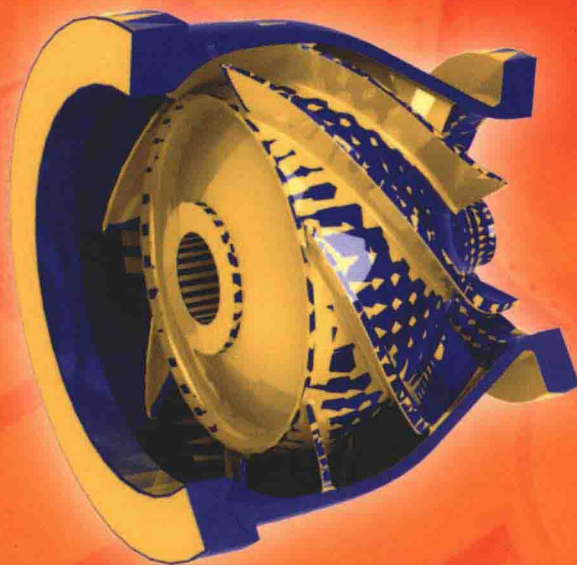


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Petrochemical Machinery Insights

Heinz P. Bloch



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Petrochemical Machinery Insights

Dedication

To the memory of Les Kane, who suggested
the *HP in Reliability* columns and started
to publish them in 1990.

As my editor, he valued integrity in both
engineering and publishing
above all else.

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Foreword

As a reliability professional who knows the needs of the industry, I tackled this writing task with the primary intent of updating machinery reliability-related topics. Suffice it to say that more than ever, modern industry is affected by equipment reliability. But it would be a serious mistake to assume that a particular facility or corporate entity can achieve its reliability goals without the support and cooperation of many interacting job functions. Moreover, equipment reliability is greatly influenced by the support and continuity given by management. I therefore included subject categories on organization, management, and training. Equipment reliability is also affected by the implementation skills of the people in the trenches, so to speak, and by the perceptions of everyone between them and higher management. Every one of us fits in somewhere and every one of us influences asset reliability. By way of an automobile analogy, the driver and maintenance technician and design engineer carry equal weight. If one of them slacks off, reliability becomes illusory. We need to apply the same logic in our plants. We must accept that our respective responsibilities overlap, that everybody matters and fulfills a role.

For accessibility, the material had to be neatly indexed and cross-referenced without undue complexity. Its relevance had to be reconfirmed by engineers and marketers who—like the author—were no longer compelled to submit their findings for approval to higher authorities whose agenda would inevitably conflict with that of the pure engineer. Such approval is often withheld in order to discourage publishing anything that could even remotely be viewed as a competitive advantage, or viewed as an endorsement, or a critically important fact. But ignorance is as dangerous as information overload; I therefore tried to come down somewhere in the middle between silence and overload.

Conveying just the right amount of useful information to the intended target audience is one of the great challenges in reliability engineering. Failure analysis, remedial steps, or desirable substitute approaches must be explained, perhaps more than just once. Good work processes encompass sound explanations. Even if impeded by an often unproductive up-and-down chain-of-command approach, good work processes must be adopted to be successful. Unproductive up-and-down wavering is occasionally found in stifling Pareto-confirming work environments. In places where Pareto's law prevails, 80% of the people are doing all the talking and 20% are doing all the work. I waited until the depressing possibility of being trapped in such a merry-go-round was no longer a

concern of mine. I can now be critical whenever criticism is appropriate. When appropriate, I can submit constructive criticism and layout and explain which reliability strategies and concepts have stood the test of time. I have found these strategies embraced by well-managed best-of-class companies; the strategies are interwoven and their implementation is shared among many job functions. In compiling this book, I could finally take whatever time was needed to give readers pertinent facts. My hope was to explain these facts in a manner that gets to the point quickly and accurately, nonjudgmental—but uncompromisingly truthful—nevertheless.

Preface

This text was compiled because of many requests to update, revise, and reissue some of the hundreds of *HP in Reliability* columns I had written in the years from 1990 to 2016. Because my mechanical engineering career actually began with graduating from the New Jersey Institute of Technology (Newark, New Jersey) in 1962, I was at first inclined to call this book “50 Years of Machinery Notes.” Then again, the mere thought (or even the remote possibility) of such a title scaring away readers made me rethink. Nobody would want to sift through 50 years of notes. So, I decided to give it the title “Petrochem Machinery Insights,” which sounds better and, hopefully, not too pompous. The intent and scope of the book is easily explained: You should not have to read volumes of textbooks to find the one important nugget of information that you have tried to locate, or that's really the only item of interest to you.

My target readership includes operating technicians, maintenance professionals, reliability engineers, and midlevel and senior managers. Some readers will be working in refinery and process plant shops; others could be field mechanics, millwrights, project engineers, midlevel managers, and project executives. All of them are people whose actions influence asset reliability. For many years, I have seen merit in giving these widely divergent job functions easy access to relevant material. I was always pleased when subject matter experts (SMEs) agreed with me, and many SMEs, whether active or retired, are probably aware of the significance of this material. Yet, while this group of peers and colleagues are equally knowledgeable, they may not have had similar opportunities to transfer their experience into written words. Time, motivation, and opportunity have to come together as we publish relevant highlights of our work-related insights.

For my part, and also because of the encouragement passed on by many readers, I assumed that they (and you) would benefit from a no-nonsense text. And so, the text comprises many updates of the material I had written from the early 1990s until possibly only 3 or 4 months before this book went into print. I also assumed that readers wanted me to select and craft and condense the pages of this book while leaving out consultant-conceived generalities. They've probably heard enough nonoffending, no value-adding generalities. Chances are that their equipment life expectancies, or the profitability of their facilities, fell short of reasonable projections. Could failure to meet expectations be rooted in issues that are not popular to pursue? Many SMEs agree with our contention that

basing one's actions on vague generalities will be ineffective, wasteful, or even dangerous. Could lack of success be rooted in a mere anecdote being passed down and being applied stripped of its original context? Could it be because, in the past, action was often initiated by listening to opinions instead of facts? Is it possible that the core material, the monthly Reliability Columns previously published in a premier engineering journal, was either not being read or had been forgotten by the intended audience? It became clear to me that this writing project had to be tackled by re-reviewing the many folders and files containing background material to my monthly *HP in Reliability* columns. These and another potential pool of source material would be some of the hundreds of articles I had compiled and issued in the years since 1989. In that year, I had finally obtained a word processor with adequate storage capacity to file away thousands of pages. Wading through these accumulated pages and the associated stack of personal material, I tried to be mindful of its relevance for an audience made up of many job functions, skills, age groups, backgrounds, and talents. I was also thinking of the task of future translators who surely would not want to waste time struggling with, or deciphering, fuzzy or hidden messages.

Here, then, is the final product. I hope that you will find it useful.

Acknowledgments

I consider myself fortunate to have met, over the past six decades, hundreds of companies and individuals who cheerfully responded to my requests for literature. Whenever necessary, I obtained their permission to embed excerpts from their prior writings or illustrative materials for use in my columns, books, tutorials, conference papers, and articles. As I later either restored or resurrected the contact, I have tried to communicate with many of their successor companies. My attempts were not always successful. At times, there was no response to my request. That's easy to understand: People are busy and times have changed. Information sharing is not always encouraged. Still, many companies and individuals in the United States (some in Germany, Saudi Arabia, Switzerland, and Japan) responded favorably and even enthusiastically to my requests—I am greatly indebted to them. They are acknowledged in the image credits you will find elsewhere in the front matter of this book.

Introduction

This is not just another asset reliability text. The book represents an unusual collection of relevant material. It's a guideline text that explains how asset management, to be useful, must be further separated into application and implementation details. It's a deliberately crafted synopsis or anthology of reliability improvement matters. The reader might consider it a book of essays on reliability themes. These themes are both stand-alone and interwoven; either singly or collectively, they give insight into certain maintenance details and reliability concepts. For a certainty, these concepts and details reach far beyond the endless reams of consultant-conceived generalities that one finds in some publications—publications that often try very hard to please their advertisers.

While it's not my intention to say that true reliability professionals must shun or disregard consultants' input, it is also true that great benefits are traceable to reliable homegrown SMEs with the ability to spell out and pursue actionable detail. As this text goes to print, we can observe training needs that often go unacknowledged. The unintended consequence is lingering issues with budgets for grassroots and existing plants. For lack of training, we accept cost estimates that cover only the outlay for the cheapest, potentially maintenance-intensive equipment. As these cost estimates then become rigidly frozen allocations and appropriations, all hoped-for future reliability achievements are doomed. By mistakenly accepting the notion that assets can be improved once the plant is running, the uninformed decision-makers frequently lock asset owners into a cycle of unprofitability and downtime risk. I liken this pathway to the foolishness of attempting to turn a low-cost two-seater sports coupe into a safe and solid school bus. No amount of wishful thinking will let you do that in a profitable manner.

A simple example of an actionable detail alludes to lubricant delivery flaws in thousands of process pumps. Process pumps in the (primarily) 10–200kW size range usually incorporate rolling element bearings, and many of these bearings fail long before they have reached their published design lives. Planning and carrying out machinery quality assessment (MQA) is important in this regard; MQA should provide the answer. We review component design details early in the project and visualize probable installation and maintenance practices that will likely prevail once the equipment is delivered or after the plant is commissioned. During MQA, we should identify and find risky elements or

issues that usually culminate in repeat failures. So why do so many bearings fail early? Why do some process pumps fail repeatedly or randomly? We should care about the matter.

User questions on why pump bearing lubrication providers do not offer answers need to be explored. By being observant and applying the right failure analysis approach, we may learn more about why the industry often struggles with elusive failure causes. Answers can be found if we work with manufacturers that have, and will share, application engineering know-how. This text will provide ample details on how we can benefit from working with them.

Another example of an actionable detail is found on the pages in this text that deal with little-known pump types or a number of pages on well-represented process pumps that deserve to be upgraded. Again, the details on how and why certain parts should be upgraded must be discussed and are brought to the readers' attention in this text. Without overarching candor, discussion, and explanation, my narrative would risk being classified as simply more consultant-conceived generalities. I did not want this to be the case.

The segment on root cause failure analysis makes a point made often before. It alerts readers to the fact that thousands of process machines are plagued with repeat failures. I follow up by again bringing a bit of simple commonsense logic to their attention; there are only two possible explanations why a facility experiences repeat failures: reason (1) might be that the troubleshooters or failure analysts involved have not found the real cause of the failure and reason (2), the root cause of failure is in fact known, but nobody cares to address it. Long-held biases and unspecified agendas get in the way. That said, I would like readers to consider a sobering definition: a mistake repeated more than once is called a decision. There are only two types of decisions: right ones and wrong ones.

In essence, this book tries to teach how mistakes can be remedied or avoided. As you grasp the underlying principles and come to appreciate the near-impossibility of fully separating the multitude of interwoven reliability topics, you will understand how and why so very many topics cross over or overlap into different subject categories. That understanding will get you well on your way to making good decisions, the right decisions. Summing up: throughout the time it now took to collect, condense, and update what I had published in the years since my first article appeared in a Processing Journal in 1974, I tried to synthesize facts and the principles that I observed. I related and commented on what I learned from, and during, my long and rewarding employment by a multinational petrochemical corporation. In this book and whenever possible, I expressed what I had absorbed while teaching over 500 workshops on six continents. And rather late in the game, I thought of a very famous wise man's proverb: "the king finds pleasure in a servant who acts with insight." Well, this book should assist the reader in doing just that—acting with insight.