Solving Materials Problems

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Introduction

There are many articles and books available now about failure analysis or failure investigations. In addition to introducing methodologies and specific techniques, most books contain case studies or examples of very thorough investigations that can be interesting. Many of the case studies are limited to a failed component with varying degrees of consideration of the service conditions.

I will not try to summarise this available information but I would like to make some observations based on many investigations over a wide range of subjects and fields.

Very early stages of an investigation

When a prospective client first makes contact we want to learn more about the problem and how we could best assist the client.

What is wanted? Did acid cause the corrosion? Was the correct material used? What is the tensile strength? How long will the pipe last? What is the root case? When did the fatigue crack start?

Why is it wanted? Purpose – internal to the company, dispute with suppliers, insurance claim or legal case? These are scope-indicating factors for the degree of certainty required ranging from possible, balance of probabilities or probable to proof beyond reasonable doubt.

What limitations? Information, evidence, time, money

How does the client want it done? Is the request and any suggested methods reasonably likely to provide what is really needed?

How would it be best to proceed? A commercial testing firm or another consulting company may be better able to assist the potential client.

In many cases a preliminary report is sufficient to meet the needs of the client and can also present the basis of a more complete investigation and a full report if needed by the client.
**Brief coverage of some examples**

- Failed mounting brackets on an axial fan were seen as the primary damage but were actually secondary damage.

- Failed piston from a diesel pile hammer with obvious mode of failure and less obvious probable cause.

- Turbocharger explosion on a ship with extensive damage but the investigating team were looking for the root cause and sought the assistance of metallurgists.

- Failure of a repaired pipe joint during pressure testing was not simply poor site practice but left many unanswered questions.

- Bolts can fail by fatigue after prolonged service or suddenly after a short period – but why?

- An LPG pump failed soon after commissioning but was it a material failure?

**Throughout failure investigations, it is essential to keep asking questions like:**

- **What** happened? This is factual information.
- **How** did it happen? This is requires identification of the mechanism and circumstances that were involved at the time of the incident.
- **Why** did it happen? This requires careful determination of the factors involved and the root cause if possible.
- **How** can it be prevented from happening again? This needs assessment of what measures are technically feasible and economically viable and which one is most effective. Unfortunately, most investigations stop short of this stage or fail to implement the conclusions.

**Closing points**

- a. The examples illustrate specific requests that lead to more complete assessments of the situation.

- b. There are cases where the material is the basic cause of the failure but most times there are other, more important factors.

- c. Technical experts need to base their opinions on evidence and should remain open minded, unbiased and independent especially for disputes where their report may go to a court or arbitrator. The independence is in the long-term interests of the client to reduce their costs.

**Questions and answers are welcome!**