The Importance of Engraining Safety, Health and Environmental Concepts in the Chemical Engineering Curriculum

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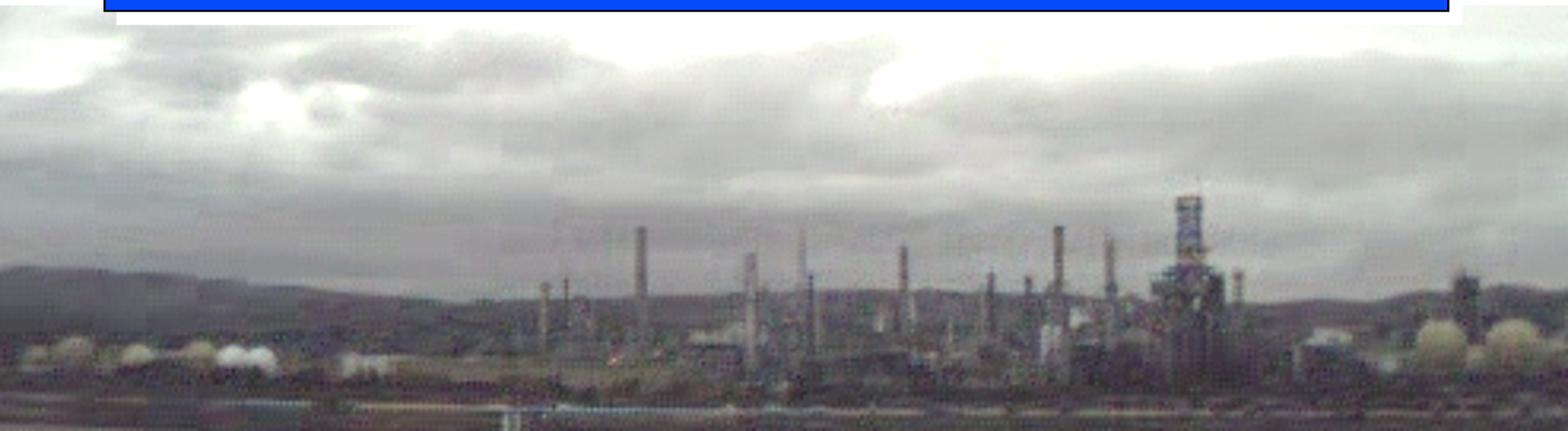


Major Process Industry Accidents

- Fires
- Explosions
- Toxic releases

Major Process Industry Incidents

Incident Outcomes

- **Fires**
- **Explosions**
- **Toxic Releases**

Consequences

- **Fatalities**
- **Injuries**
- **Environ. Damage**
- **Property Damage**
- **Evacuations**
- **Business Losses**
- **Plant Closings**
- **Fines, Lawsuits**

Key Questions

1. Why do we need process safety?
2. Why do we need to include it in the chemical engineering curriculum?

An Old Proverb….

“If you lose something, go back to the last time you had it…..”

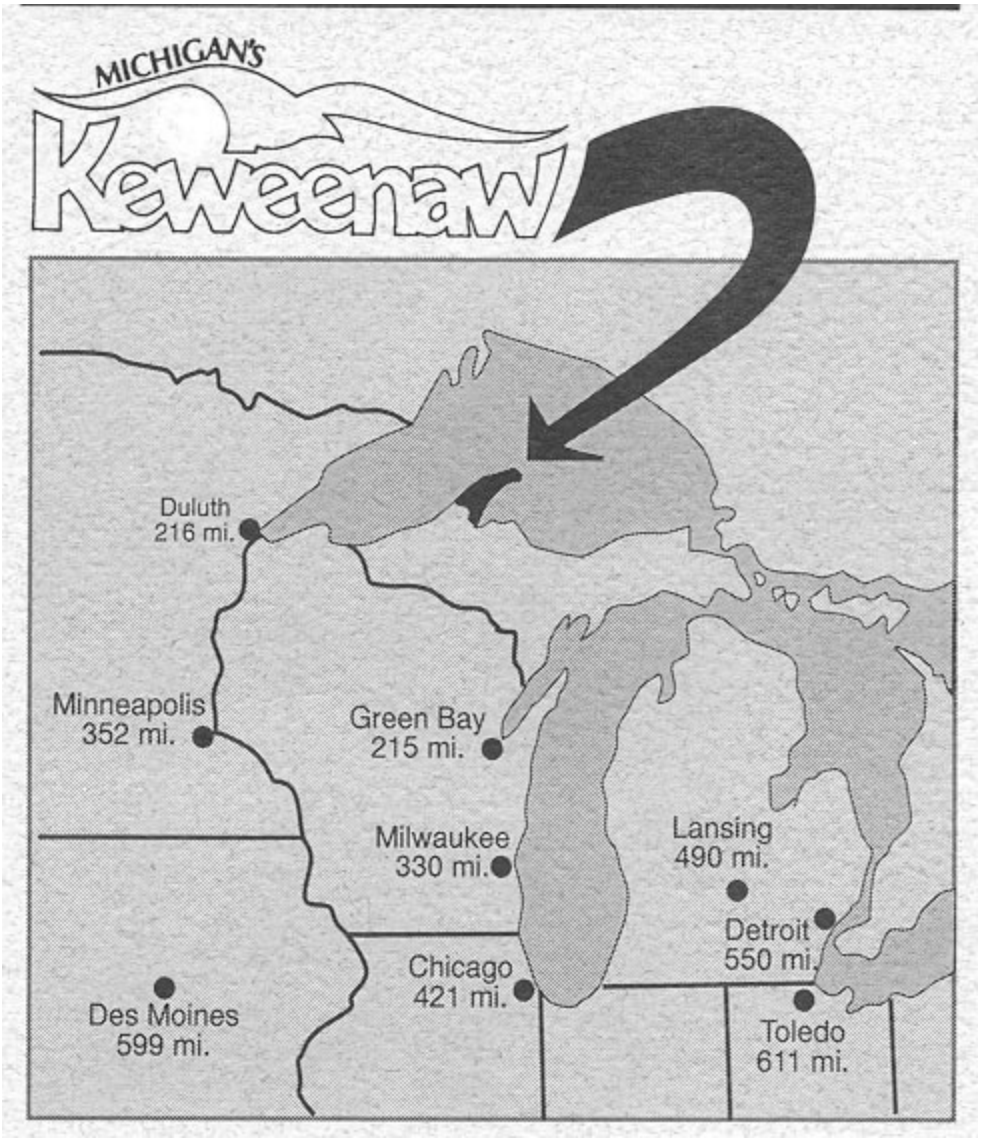
Change this to:

“If you have something, go back to the time when you didn’t have it…..”

“If you now have safety, go back to a time when safety wasn’t important…”

As luck would have it, the history in the area around Michigan Tech has the answer to this question.

The Upper Peninsula ("Da UP") of Michigan



The Keweenaw ("portage" in Objibwa) peninsula is a peninsula jutting out into Lake Superior.

The Keweenaw Peninsula

Michigan Tech

History of the UP

1840: Large copper deposits noted by Douglas Houghton

1844: Lake Superior Copper Company founded.

1885: Michigan Mining School started in Houghton (this will become Michigan Tech).

1887: State law enacted. Mine inspectors required and inquiries and reports on fatal accidents required.

1900s: As copper companies went out of business, their papers were donated to the MTU archives.

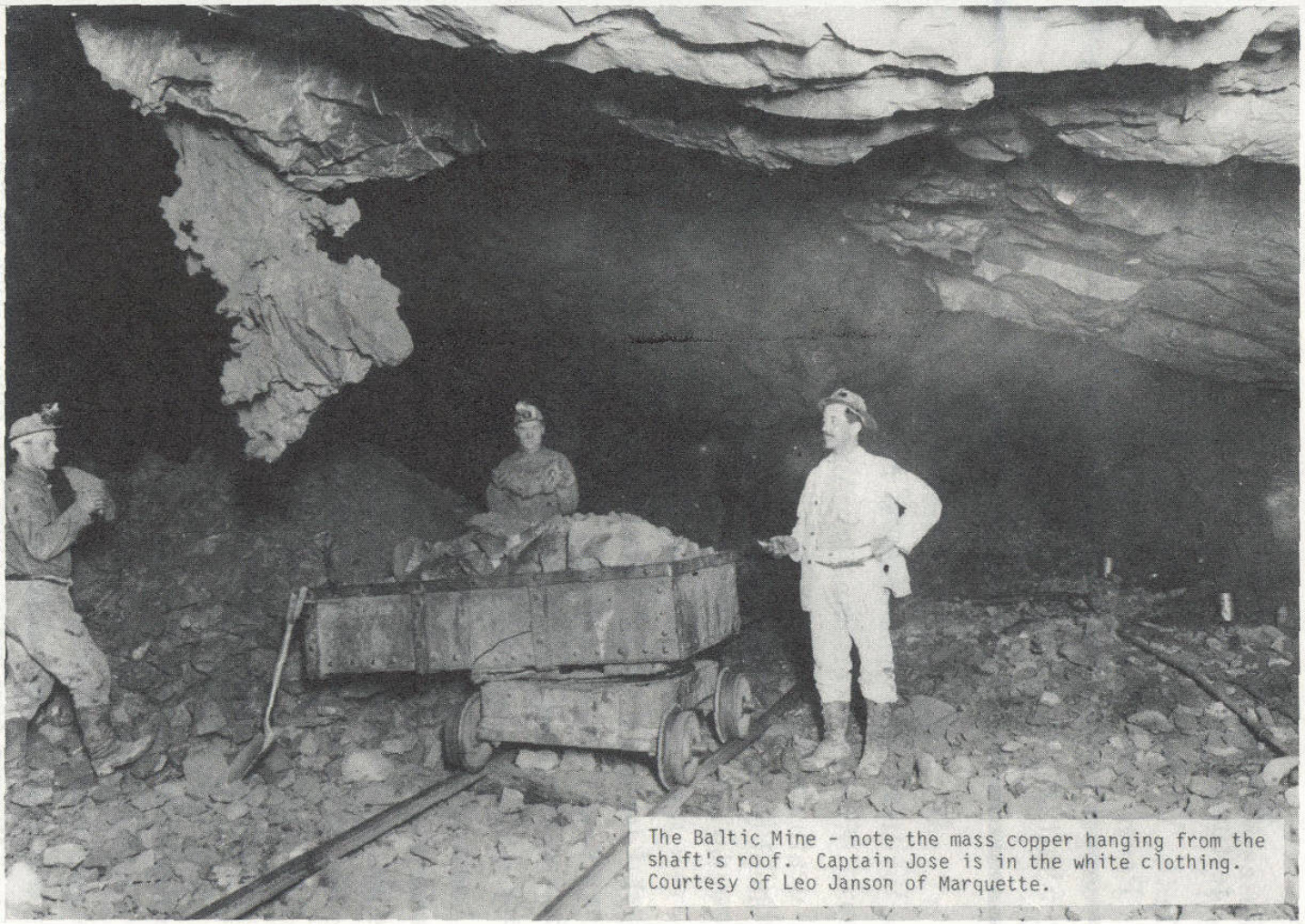
1960s: Largest mine, Quincy Mine, closed.

1990s: Last commercial copper operation terminated.

Copper

Copper was mined as large pieces of 99.9% purity!

Copper



The Baltic Mine - note the mass copper hanging from the shaft's roof. Captain Jose is in the white clothing. Courtesy of Leo Janson of Marquette.

Posted Safety Policy

The company looked after the safety of their tools and equipment, but the men were responsible for their own safety. Workers learned their jobs and safety practices from other experienced workers.

Compare this to today's practices!

Mine Fatalities

In 1891, 28 miners were killed. The total number of miners that year was 7,702.

(7,702)/28 = 275 ➔ 1 in 275 workers died in one year!

Fatal Accident Rate (FAR):

FAR = (Number of fatalities x 108)/(Total hours worked)**

= 121

In 1990, the FAR for the chemical industry was 1.2, two orders of magnitude less!

Mine Fatalities

Despite this, mine jobs were prized and attracted workers from all over the world.

Widows were paid $50 as a death benefit ($961 in 2002 dollars).

Widows were also allowed to stay in company housing until they decided to more out.

1.Why do we need process safety?

I believe the difference between then and now is related to the societal value for a human life. In 1900, the average life expectancy was 47 years. In 2000, it was 78 years. In 1890, life was also uncertain, with rampant illness and disease.

Process safety, and safety in general, is important today because our society places a large value on human life.

2.Why do we need to include safety in the chemical engineering curriculum?

In the late 1980s and early 1990s, I was involved with a training program for a major chemical company to improve the safety in a newly acquired division. They had several major incidents and their accident incident rate was too high. This division had about 20 plant sites all over North America.

Safety Program

Monthly meetings at a selected site:

- **2 to 3 day meeting**
- **Required of all safety folks at all plant sites.**
- **Included technical presentations / workshops.**
- **Included tours of the plant site with group critique of identified problems and improvements.**

A major effort was also done to improve the design and safety systems at each site ($40 MM).

This program lasted for almost three years. Eventually, improvement was seen, but it came slowly, and at great expense of $ and effort.

Major Conclusion

It is very difficult to retrain workers once they have been doing things wrong for any period of time.

<u>Corollary:</u> The workers need to know proper safety practices, culture and technology as early as possible.

MTU Unit Operations Lab

In the early 1990s, the lab was operated in a regulatory mode. The faculty continuously inspected the lab and informed students when things were not done properly. A hazard reporting system was in place, but not used adequately.

Problem: **Same situations kept arising.**

Remedy

- Students were told that they held the primary responsibility for the UO lab safety program and it was up to them to make it work.
- Required safety course prior to lab.
- Student run monthly safety meetings:
  1. Review of hazard reporting forms.
  2. Pre and post lab inspections by safety group.
  3. Technical presentation on some aspect of safety.
  4. Discussion / resolution of issues.
- Faculty audit.

Results / Conclusion

Result: The safety in the UO lab improved dramatically, with little additional effort by the faculty.

Conclusion: Fresh and youthful minds are easy to train to do things the correct way.

2. Why do we need to include safety in the chemical engineering curriculum?

Answer: This is the point in the student's career when it is easiest to instruct them in safety culture, management and technology.

If the students learn the incorrect way as an undergraduate, they are likely to continue the practice.

Side benefit: We get all students here, including those that go to small companies or companies with inadequate safety.

Summary

1. Safety is important because our society places a great value on human life.
2. Undergraduate instruction in safety is very important because young minds are very amenable to doing things the correct way.


Questions?