Chemical & Process Safety: Lessons from Past Explosions Stats and Facts



FACTS

1. **Vapor Cloud Ignition:** Leaking flammable gases or vapors can accumulate undetected; one spark from equipment, static, or tools can trigger an explosion with no warning.
2. **Dust Accumulation:** Fine combustible dust—from grains, metals, wood, plastics, or chemicals—can ignite violently when suspended in air by even a small disturbance.
3. **Inadequate Venting:** Poor pressure-relief design allows vessels, piping, or reactors to over-pressurize during abnormal conditions, causing catastrophic rupture.
4. **Process Upsets:** Temperature, pressure, or flow deviations that go unnoticed can trigger runaway reactions, boiling liquid expansion (BLEVE), or thermal decomposition.
5. **Improper Maintenance:** Corroded pipes, worn valves, and failing seals create leaks that become ignition or explosion sources when not identified early.
6. **Bypassed Safeguards:** Disabled alarms, interlocks, or automatic shutdowns remove the final protective barrier against dangerous process conditions.

STATS

- The U.S. Chemical Safety Board (CSB) investigates around 20 major chemical incidents every year, many involving explosions, fires, or runaway reactions.
- In 2023, hazardous chemical accidents in the US occurred nearly daily, involving over 3,200 facilities at heightened climate-related risks, leading to fires, explosions, and spills that injured workers and residents.
- Between January 2021 and October 2023, at least 825 chemical incidents, including fires and explosions, were reported in the US, leading to nearly 200 community evacuations and highlighting ongoing process safety gaps.
- From 2020-2024, Canadian lost-time claims from chemical exposures in manufacturing and warehousing exceeded 10-15% of total claims, often tied to preventable explosions in high-risk sectors like petrochemicals.
- More than 30% of CSB-investigated explosions involved flammable vapor releases that went undetected due to poor monitoring or equipment failure.