Brewery Burns - Causes and Avoidance

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2017 Craft Brewers Conference, Washington, DC
Don’t Get Burned!

• Burns are...
  • VERY PAINFUL
  • SOMETIMES FATAL
  • SLOW TO HEAL
  • EMOTIONALLY SCARRING
  • EXPENSIVE

• Burns in the Brewery…
  • HAVE MANY CAUSES
  • MORE COMMON THAN REPORTED
  • CAUSE LONGTERM DISRUPTION
  • EMBARRASSING FOR VICTIMS

Good News! Burns are preventable through improved work practices, engineering controls and personal protective equipment.
Cost Example of a Serious Burn [1]

<table>
<thead>
<tr>
<th>COST ELEMENT</th>
<th>TYPICAL COST</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct costs</td>
<td>$ 37,389</td>
<td>Workers Comp</td>
</tr>
<tr>
<td>Indirect costs</td>
<td>$ 41,127</td>
<td>Employer pays</td>
</tr>
<tr>
<td>Total before fines</td>
<td>$ 78,516</td>
<td></td>
</tr>
<tr>
<td>Sales to cover total before fines</td>
<td>$ 314,064</td>
<td>Assume 25% gross sales margin</td>
</tr>
<tr>
<td>Incidentals…</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OSHA fine(s)</td>
<td>$ 12,000</td>
<td>Minimum for each “serious violation”</td>
</tr>
<tr>
<td>Workers Comp premium EMR</td>
<td>? ? ?</td>
<td>Min. 3 yrs before rate returns to pre-burn multiplier</td>
</tr>
<tr>
<td>Loss of productivity</td>
<td>? ? ?</td>
<td>Hiring, training a replacement; equipment upgrades</td>
</tr>
</tbody>
</table>

Today’s Talk

• What is a Burn?
• Root Causes of Burns
• Burn Hazard Assessment
• Types of Burns
  • Hazard assessment
  • Avoidance strategies
• Experiences of Your Peers
What is a Burn?

*Tissue damage caused by rapid heating or chemical reaction*

- **Severity increases due to**
  - Energy transfer
  - Duration

- **Results**
  - Tissue and nerve damage
  - Slow, painful recovery
  - Skin grafting or replacement
  - Physical and psychological scars
  - Systemic effects if >30% of body

Source: National Center for Biotechnology Information, after Jackson, 1947.
Burning by Degree

1\textsuperscript{st} Degree ("superficial thickness")
- Epidermis injured
- Usually no lasting affects

2\textsuperscript{nd} Degree ("deep partial thickness")
- Tissue damage to epidermis and dermis
- Blistering is common

3\textsuperscript{rd} Degree ("full thickness")
- Destruction of epidermis and dermis
- Triggering widespread systemic response
- Lengthy, complex treatment required

Source: Nurselabs.com.
Systemic Effects Beyond the Burn Site

- **Body Responds to Burn by**
  - Releasing cytokines and other anti-inflammatory mediators
- **Results**
  - Bronchoconstriction
  - Increased basal metabolic rate
  - Cardiovascular issues
    - Heart contractions decreased
    - Vasoconstriction of organs
  - Reduced immune response

Root Causes of Burn Accidents

• Failure to Understand Hazards
  • Hazard Assessment Process
    1. Walk through each task
    2. ID hazards and sources
    3. Organize hazards step by step
    4. Analyze hazards: type, severity, likelihood
    5. Specify “hazard controls”
  • Utilizing Hazard Controls
    • Preventative and protective steps that eliminate or minimize hazards
    • Build hazard controls into SOPs

• Human Factors
  • State of Mind
    • Rushing, Frustration
    • Fatigue, Complacency
    • Distraction
  • Risky Behavior
    • Exceeding design specs
    • Line of fire
    • Balance-traction-grip
Brewery Hazards & Hazard Assessment Tool

HAZARD ASSESSMENT

1. Conduct a Walk-through
   Survey the area. Think through every step involved in completing the task. Describe the activities associated with each task.

2. Identify Hazards and Sources
   Use the examples of hazard types shown on the reverse of this card to identify hazard types and where they may occur.

3. Organize Hazard Data
   For each step in the task, compile a list of specific hazards that could be encountered and understand their consequences, i.e. describe possible injury.

4. Analyze Hazard Data
   Evaluate hazards by type, risk likelihood, and severity of possible injury. Note where multiple hazards coexist.

5. Specify Hazard Controls
   For each hazard, specify one or more hazard control strategies, which could include: engineering controls, administrative control and safe work practices, and personal protective equipment.
Hazard Assessment for Burn Hazards

1. Walk through each task
2. ID hazards and sources
3. Organize hazards step by step
4. Analyze hazards by type, severity, likelihood
5. Specify “hazard controls”
Types of Burns

1. **Thermal Burns**
   1. Scalding liquids
   2. Boiling liquids
   3. Steam
   4. Surface contact – hot & cold

2. **Chemical Burns**
   1. Corrosives – acids & caustics
   2. Oxidizing sanitizers

3. **Electrical Burns**
   1. Electrocution
   2. Arc flash

4. **Robert Burns**
   “There is no such uncertainty as a sure thing.”
Hazard Assessment for Various Burns

HA – Name of Hazard

• Description of principal hazard
• What causes this hazard?
• Likelihood/Severity

• Hazard Controls
  Safe Work Practices
  Administrative Controls
  Engineering Controls
  Personal Protective Equipment
1. Thermal Burns in Brewhouse Ops

1.1 HA – Hot Water Contact

- **Hazard**
  Scalding water/wort 140-180°F
- **Failures/Errors**
  Hose/fittings/sprayer failure
  Manual valve operational mistake
- **Likelihood/Severity**
  Brief exposure, 1st - 2nd degree burns
- **Hazard Controls**
  Maintain equipment
  SOPs/Operational training
  Hand/eye/skin protection
  Long pants over boots
1. Thermal Burns in Brewhouse Ops (cont.)

1.2 HA – Boiling Wort Contact

• Hazard
  Scalding wort 180-215°F

• Failures/Errors
  Procedural
    • Overcharging kettle volume
    • Applying excessive heat
    • No foam inhibitor
    • Valve/clamp mistake
  Equipment
    • Absence of foam cutoff switch

• Failures/Errors
  Behavioral
    • Adding hops too quickly
    • Exposed position near manway
    • Exposed beneath kettle/deck
  Garments
    • Not wearing long pants
    • Not wearing industrial boots
    • Tucking pants into boots
    • Not wearing eye, hand, foot protection
1. Thermal Burns in Brewhouse Ops (cont.)

1.2 HA – Boiling Wort Contact

- **Likelihood/Severity**
  - Extended exposure – wort is sticky
  - Large contact area on body
  - Severe: 2\textsuperscript{nd} & 3\textsuperscript{rd} degree burns

- **Hazard controls**
  - SOPs
  - Safety training

- **Hazard controls (cont.)**
  - Procedural knowledge
    - Trimming heat appropriately
    - Caution in hop addition
    - Use of foam inhibitor
    - Double check plumbing/wort route
    - Established emergency procedures
  - Equipment selection
    - Properly sized kettle
    - Foam cutoff switch
    - Hand/eye/skin protection
    - Long pants over boots
Real Brewery Burns

- Hot Water Immersion
- Boiling Wort Burn
1. Thermal Burns in Brewhouse Ops (cont.)

1.3 JHA: Steam Contact

- **Hazard**
  Steam is >212°F

- **Failures/Errors**
  Kettle/whirlpool manway proximity
  Steam line failure (unlikely)

- **Likelihood/Severity**
  Brief exposure, 3\textsuperscript{rd} degree burns

- **Hazard Controls**
  SOPs/Operational training
  Hand/eye/skin protection
  Properly installed/maintained steam equipment
1. Thermal Burns in Brewery Operations

1.4 JHA: Direct Contact

- **Hazard**
  - Hot surfaces >140°F
  - Frost, liquified gases <32°F

- **Failures/Errors**
  - Unmarked/unprotected surfaces
  - Slipping/falling into surface contact

- **Likelihood/Severity**
  - Brief-extended exposure
  - 1<sup>st</sup>-2<sup>nd</sup> degree burns
  - Frostbite

- **Hazard Controls**
  - SOPs/Operational training
  - Skin protection
  - Hazard warning signs/markings
More Real Burns

Hot Surface Contact

Four days after frostbite injury due to contact with liquified gas.

Cryogenic Gas Contact

Sixteen months after injury.

Source: Turkish journal of trauma & emergency surgery: TJTES 16(5):433-8 · September 2010
Case Study 1

Wort Boilover
2. Chemical Burns

2.1 HA -- Acid/Caustic Contact

• Hazard
  Chemical reactions with tissue

• Failures/Errors
  Careless dispensing/mixing
  Slipping/falling into surface contact

• Likelihood/Severity
  Common exposure, severity varies
  Strength of agent
  Getting garments off
  Washing off with copious water

• Hazard Controls
  Hand/eye/skin protection
  Emergency shower close by
  Operational training
2. Chemical Burns (cont.)

2.2 JHA -- Oxidizing Sanitizer

Contact

- Hazard
  Chemical reactions with tissue

- Failures/Errors
  Careless dispensing/mixing
  Slipping/falling into surface contact

- Likelihood/Severity
  Common exposure, severity varies
  Strength of agent
  Getting garments off
  Washing off with copious water

- Hazard Controls
  Hand/eye/skin protection
  Emergency shower close by
  Operational training
Case Study 2

Hot Caustic Washdown
3. Electrical Burns

1. Electric Shock
   - Electricity travels through the body
   - <500 V not lasting
   - >500 V serious injury

Symptoms
   - Heart arrhythmia
   - Organ, brain damage
   - Difficulty breathing, speaking, hearing
   - Entry/exit wounds

2. Arc Fault
   - High voltage flash
   - Current through air or unintended path
   - Vaporizes metal
   - Expands air
   - Arc blast pressure
   - 4x heat of the sun

Symptoms
   - 3rd degree burns
   - Loss of eyesight, hearing, memory
   - Concussion - trauma

3. Electrical Burns (cont.)

3.1 HA -- Electrical Shock / Burns

- **Hazard**
  Current through conductive tissues

- **Failures/Errors**
  Amateur / unmaintained wiring
  Direct contact with active circuits

- **Likelihood/Severity**
  Brief exposure, 1st - 3rd degree

- **Hazard Controls**
  De-energization - Lockout/tagout
  Ground fault protection (GFCI)
  Waterproof housings – switch-rated plugs
  Rubberized hand/skin/foot protection
Real Brewery Burns

Eight men were electrocuted and three suffered severe electric shocks when a wire cable which the men were handling at a new “Bevo” building of the Anheuser-Busch Brewing Association, St. Louis, broke December 4 and fell on a cable belonging to the Union Electric Co., which supplies current used in the construction work.

Fourteen men, employed by the Gilsonite Construction Co., were wrecking a tower which had been used for raising concrete to the upper floors of the new building.


3. Electrical Burns (cont.)

3.2 HA -- Arc Fault

- **Hazard**
  Unintentional discharge of electricity through an unplanned path

- **Failures/Errors**
  Direct contact with active circuits

- **Likelihood/Severity**
  Brief exposure, burning metal, shock wave, extraordinary temperatures

- **Hazard Controls**
  De-energization - Lockout/tagout
  Arc fault circuit interruptor (AFGI)
  Special training, tools, PPE
First Aid for Burns

1\textsuperscript{st} degree (superficial) burns
- Cool water
- Treat to prevent infection
- Ointments are ok
- Protect during healing

2\textsuperscript{nd}/3\textsuperscript{rd} degree (full thickness) burns
- Immediate medical help / call 9-1-1
- Do not remove clothing if stuck
- No ice, ointments, cotton balls, etc.
- No home remedies, e.g. butter, eggs
Brewery Burns are Real

2 workers, Boston Beer Co., Breinigsville, PA
Boiler explosion, eye and head injuries, asbestos.

40 yr old worker, Anheuser-Busch, Van Nuys, CA
Fell into hot mash. 30% 1st & 2nd degree burns. Hospitalized.
Brewery Burns are Real

Jeff Carlson, Harmon Brewing Co., Tacoma, WA
Scalding mash water in boot. Skin grafts.

Kerry Thomas, Edge Brewing Co, Boise ID
Wort boilover. Nearly fatal complications. Skin grafts. PTSD. 5 months away from work.
Brewery Burns are Real

Nichole Reiman, Odd13 Brewing, Lafayette, CO
Direct contact surface burn. Superficial.

Adam Chandler, Oak Pond Brewing Co.
Skowhegan, ME
Hot caustic spray.
Brewery Burns are Real

Andrew Childs and Jason Bathgate, 8 Wired Brewery, Warkworth, NZ

Wort boilover. Months away from work. Skin grafts.

Jimmy Vollmer, Benson Brewery Omaha, NE

Wort boilover.
Brewery Burns are Real

Teri Fahrendorf, Great Western, Vancouver, WA
Boiling water in boot. Skin grafts.

Mark Moynihan, Knoxville, TN
Oxygen enrichment fire inside a fermenter.
75 days in burn unit. Died from injuries.
Summary – Don’t Get Burned!

Causes and Avoidance

1. ASSESS EACH TASK
2. KNOW THE BURN HAZARDS
   • Thermal burns
   • Chemical burns
   • Electrical burns
3. UNDERSTAND BURNS BY TYPE, LIKELIHOOD, AND SEVERITY
4. IMPLEMENT HAZARD CONTROLS
   • Preventative: avoid exposure
   • Protective: reduce exposure
   • Develop and adhere to procedure

Your family, coworkers, and customers want you in one piece so you can keep making the beer!
Thank You

Especially to those who shared their personal experiences.

Engage in the Safety Dialogue through:

- Brewers Association - The Forum, Safety Exchange, Lessons Learned
- Your Local Brewers Guilds and Safety Trade Associations
- Talk to your Coworkers and Colleagues