
Fundamentals of Pipeline Coatings

2019 AUCSC

Coatings Session

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Appalachian Underground Corrosion Short Course

Remember This!

- Coatings are the #1 defense against corrosion.
- Surface preparation is the most important step in the coating process.
- This is true for underground, transition, internal and above ground service.



Today's Discussion - Coating Types

- Underground coatings – buried or immersion service
- Transition area coatings
- Atmospheric coatings
- Internal coatings & linings



Underground Pipeline Coatings - Discussion

- Mill or Plant Applied
- Field Applied
- Line Coatings
- Repair Coatings
- Coating Discussion
- Coating Cost
- Coating Quality



Mill or Plant Applied

- Most economical method to apply coatings
- Highest level of quality and quality control
- Plant/Mill conditions allow use of higher performing coatings
- Normally, high quality storage, handling and shipping
- Normally allows for some coated pipe storage



Field Applied

- Costly method either over the ditch or in the ditch
- Hard to manage quality control due to environmental conditions
- Normally lower performing coatings
- Newer field coatings do allow higher productivity
- Keyhole applications can be a problem



Line Coatings

- Coal Tar Enamel
- Asphalt Enamel
- Extruded Polyethylene
- Fusion Bonded Epoxy
- Somastic
- Pritec
- Liquid Epoxy
- 3 Layer



Repair Coatings

- Tapes
- Wax
- Shrink Sleeves
- Two - Part Epoxy
- Mastic
- Misc.



Coatings Discussion

- Most important component of a pipeline
- High quality holiday free coating requires almost no cathodic protection current
- Coatings need to be specified
- Coatings need to be tested
- Every coating has a use and a procedure, however coatings are used improperly – follow procedures



Coating Cost

- Cost of material
- Cost of application
- Cost to repair
- Handling
- Expected life
- Dielectric strength



Coating Quality

- Quality determines price
- Quality is normally dependent upon surface preparation & application methods
- Quality is assured with competent inspection
- Quality is determined by good procedures and good specifications



Transition Area Coatings

- Used where piping transitions from buried service to atmospheric service
- Used to protect from mechanical damage – freeze/thaw cycle, weed whackers, gravel, etc.
- Used to protect buried service coatings from Ultraviolet light when used above ground



Atmospheric Coatings

- Various types, quality and expected life
- Primary purpose is corrosion prevention, secondary purpose is appearance
- Problem areas, flanges, nuts, bolts, hold down clamps, high temperature service, beneath insulation, through walls/foundations, etc.



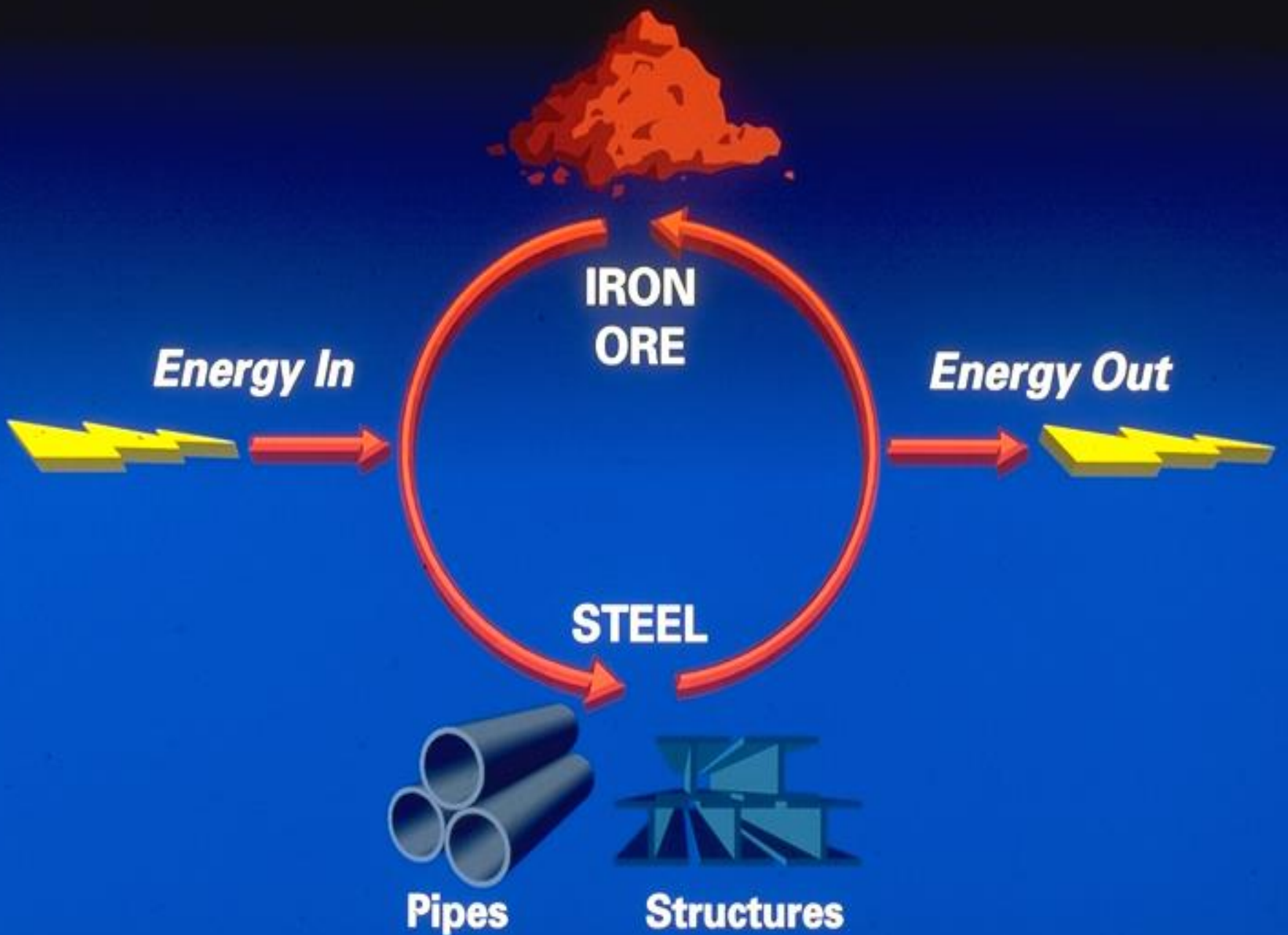
Internal Coatings & Linings

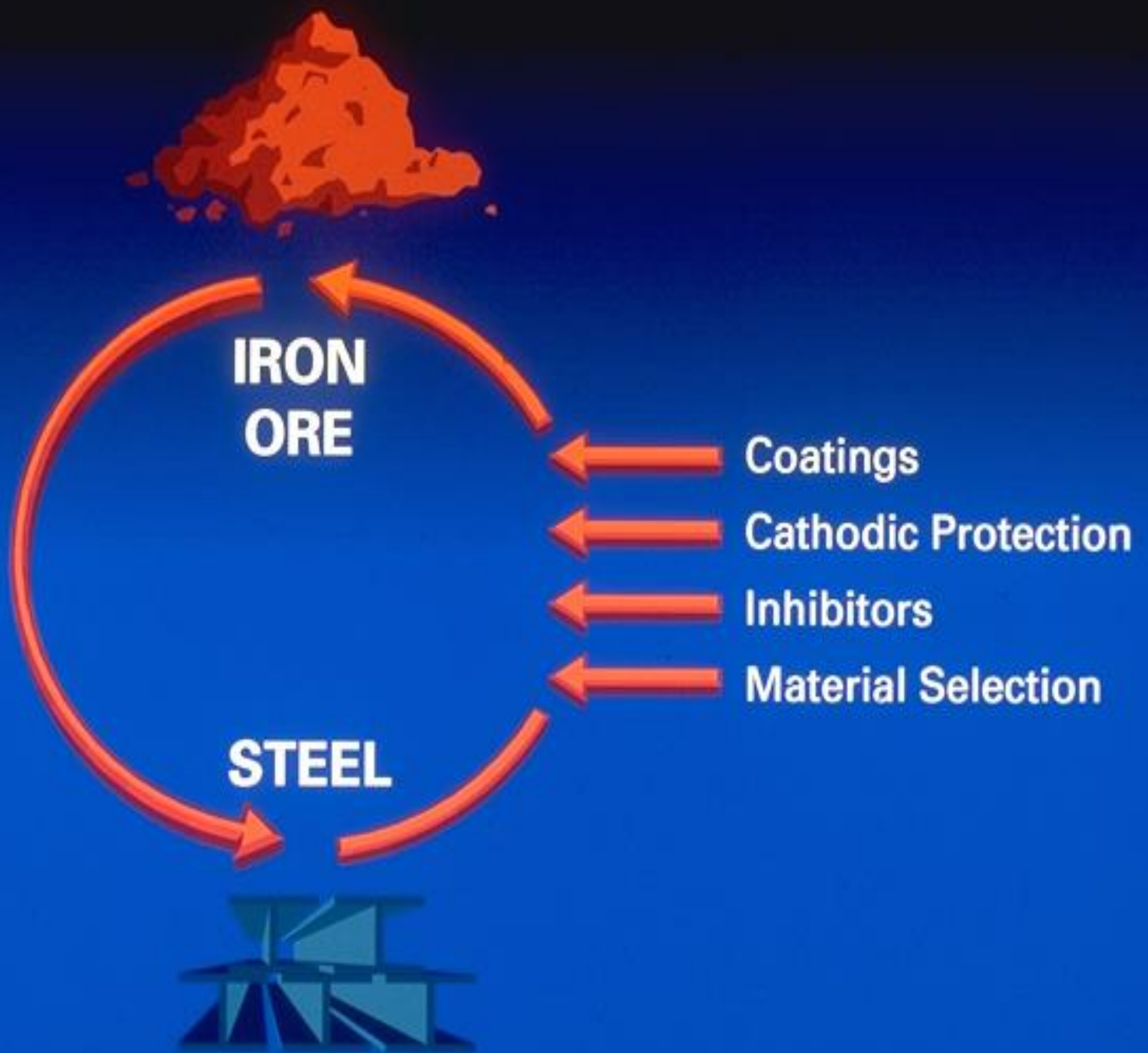
- Used to internally coat pipelines for corrosion protection and/or improved flow.
- Used to internally line tanks, process equipment & vessels for corrosion protection and/or product quality.



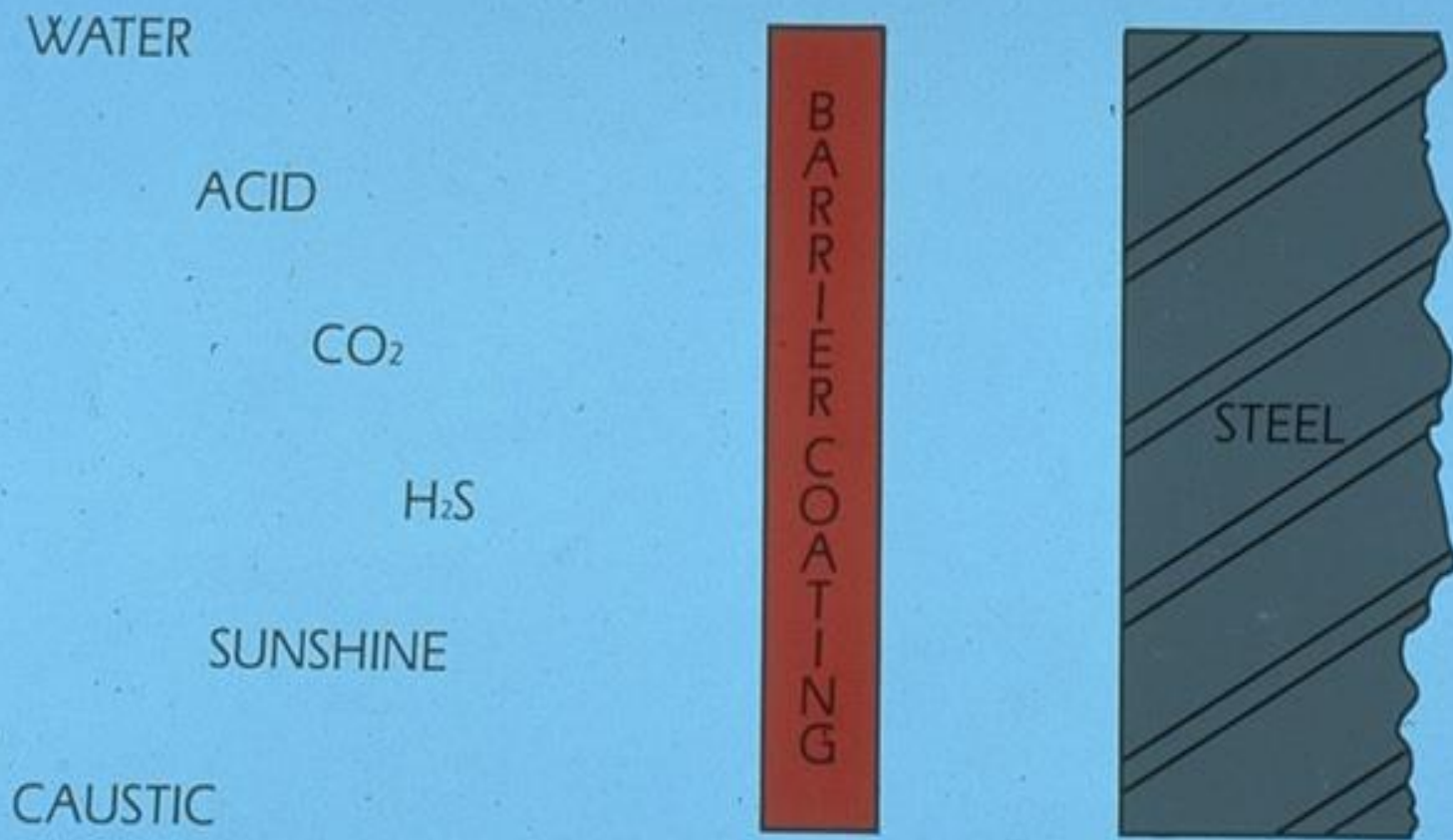
**WHAT IS
CORROSION?**

CORROSION IS THE DESTRUCTION OF A SUBSTANCE, USUALLY A METAL, OR ITS PROPERTIES BECAUSE OF A REACTION WITH ITS ENVIRONMENT.





COATING DEFINITION



A coating is a barrier to protect steel from the environment.

Perfect Coating

- Ease of Application - Anyone can put it on with a mop on any surface or from above ground.
- Cost Effective - Cost \$1.00/Gallon or less!
- Environmentally Safe and Friendly – OK to Drink it.
- Performance - Lasts forever.



Appalachian Underground Corrosion Short Course

In Reality a Perfect Coating

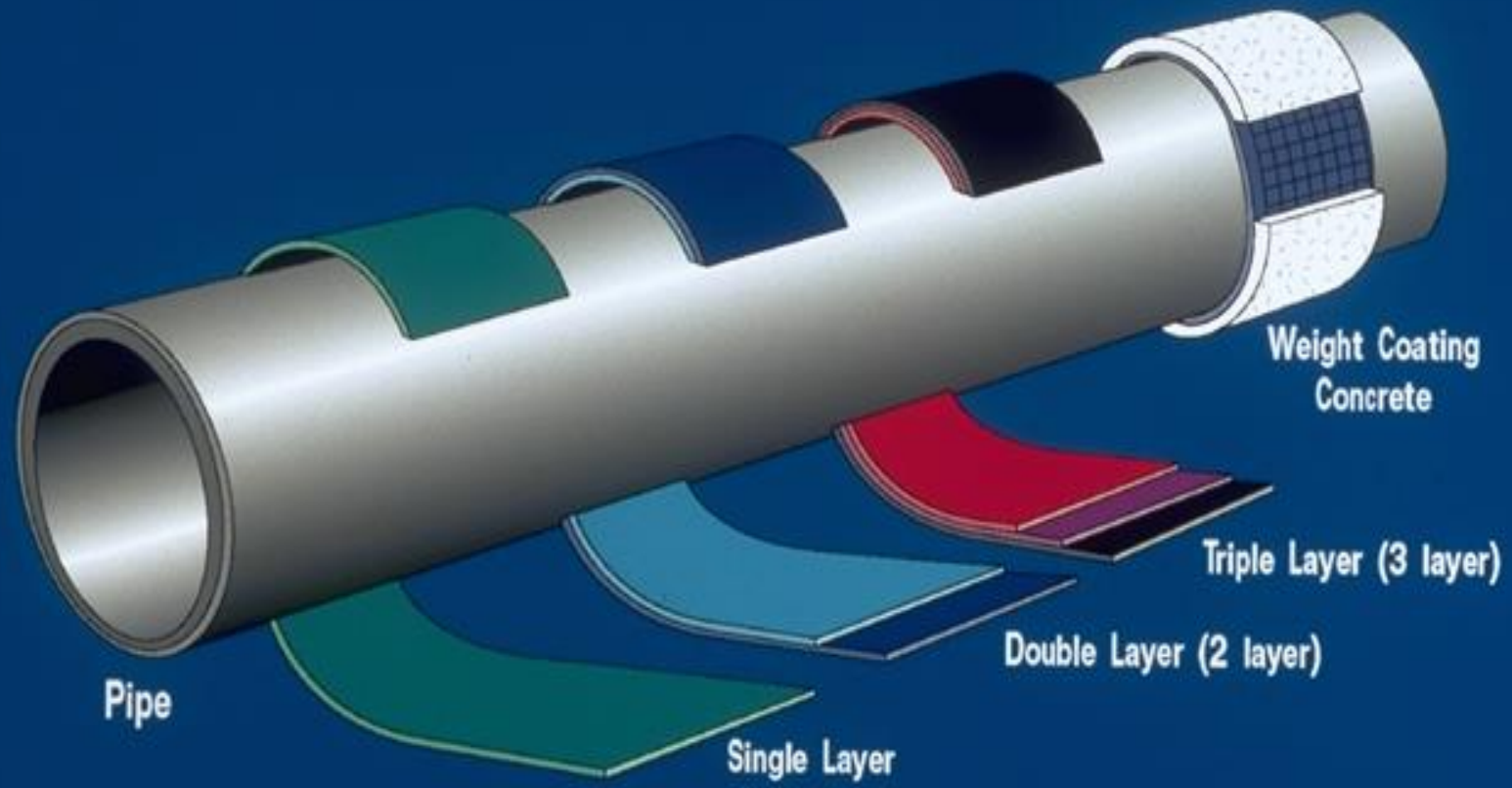
- Requires a quality standard
- Requires a quality specification
- Requires a quality coating mill
- Requires a quality material or materials
- Requires a quality inspector or inspectors



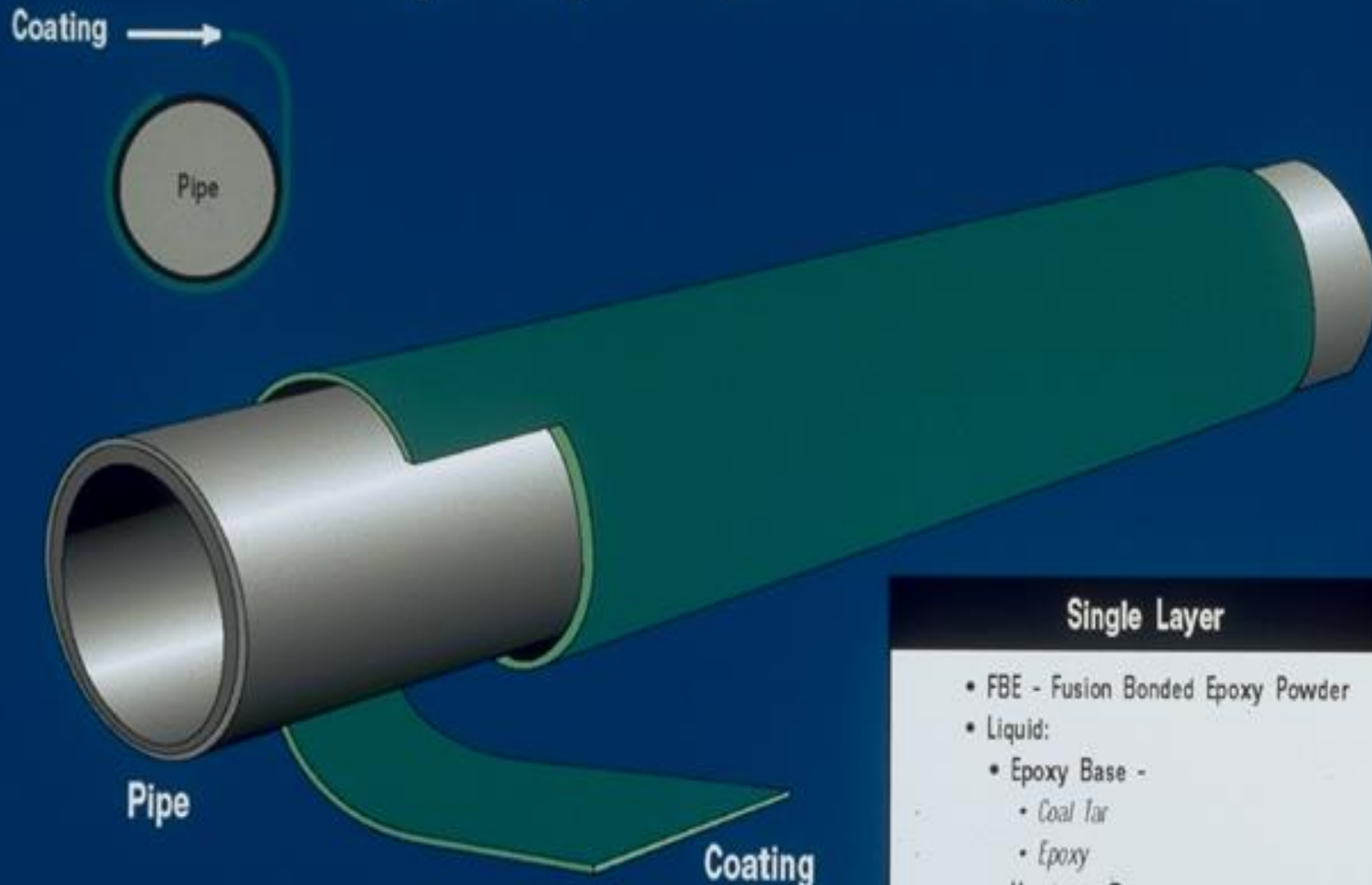
General Requirements of a Pipeline Coating

- **Ease of Application**
- **Good Adhesion to Pipe**
- **Good Resistance to Impact**
- **Flexibility**
- **Resistance to Flow**
- **Water Resistance**
- **Electrical Resistance**
- **Chemical and Physical Stability**
- **Resistance to Soil Bacteria**
- **Resistance to Marine Organisms**
- **Resistance to Cathodic Disbondment**
- **Resistance to Soil Stress**

Pipeline Corrosion Coatings



Single Layer Pipeline Coating



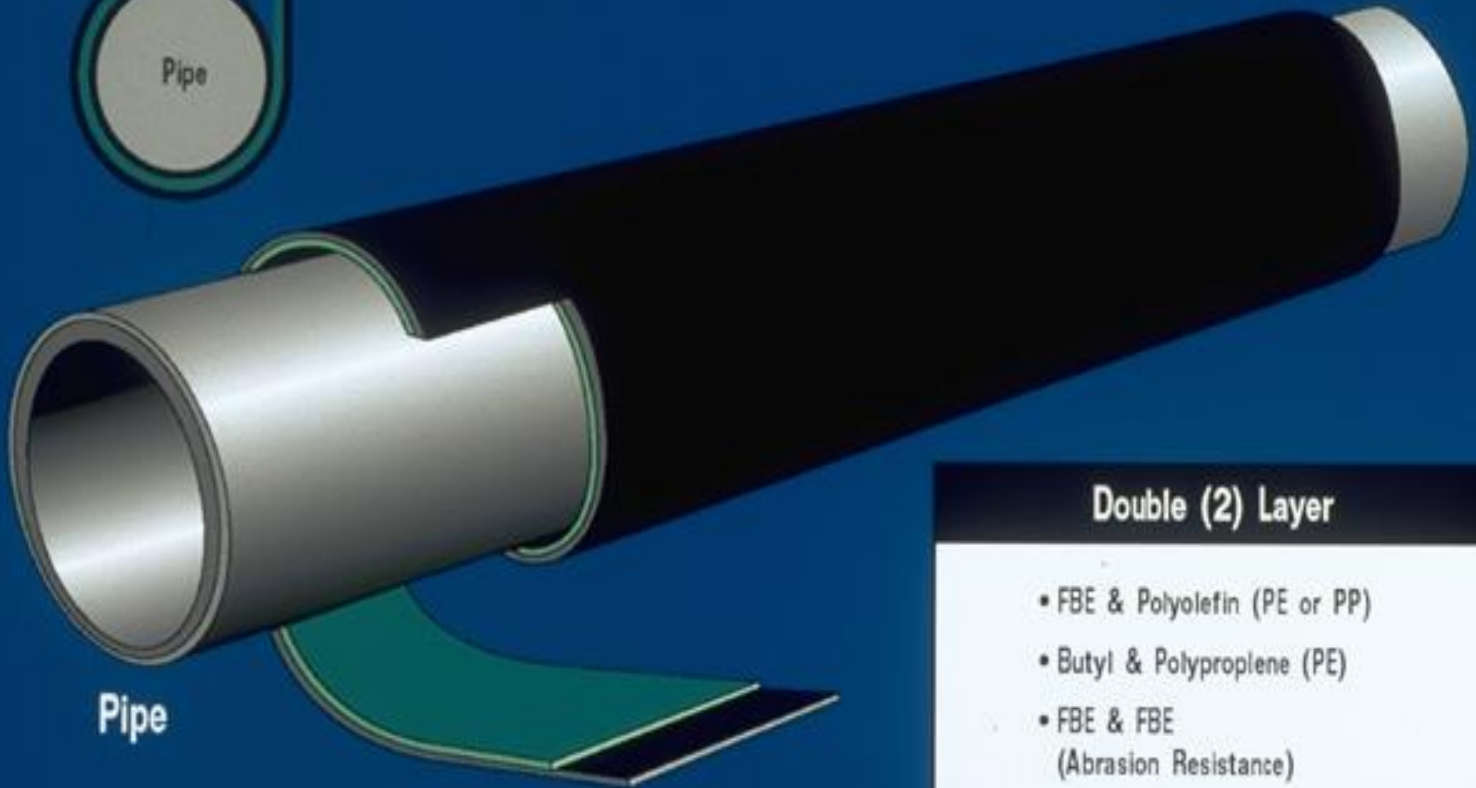
Single Layer

- FBE - Fusion Bonded Epoxy Powder
- Liquid:
 - Epoxy Base -
 - Coal Tar
 - Epoxy
 - Urethane Base -
 - Coal Tar Urethane
 - Urethane
- Wax Tapes

Double (2) Layer Pipeline Coating



2nd Coat →
1st Coat →



■ 1st Coat

■ 2nd Coat

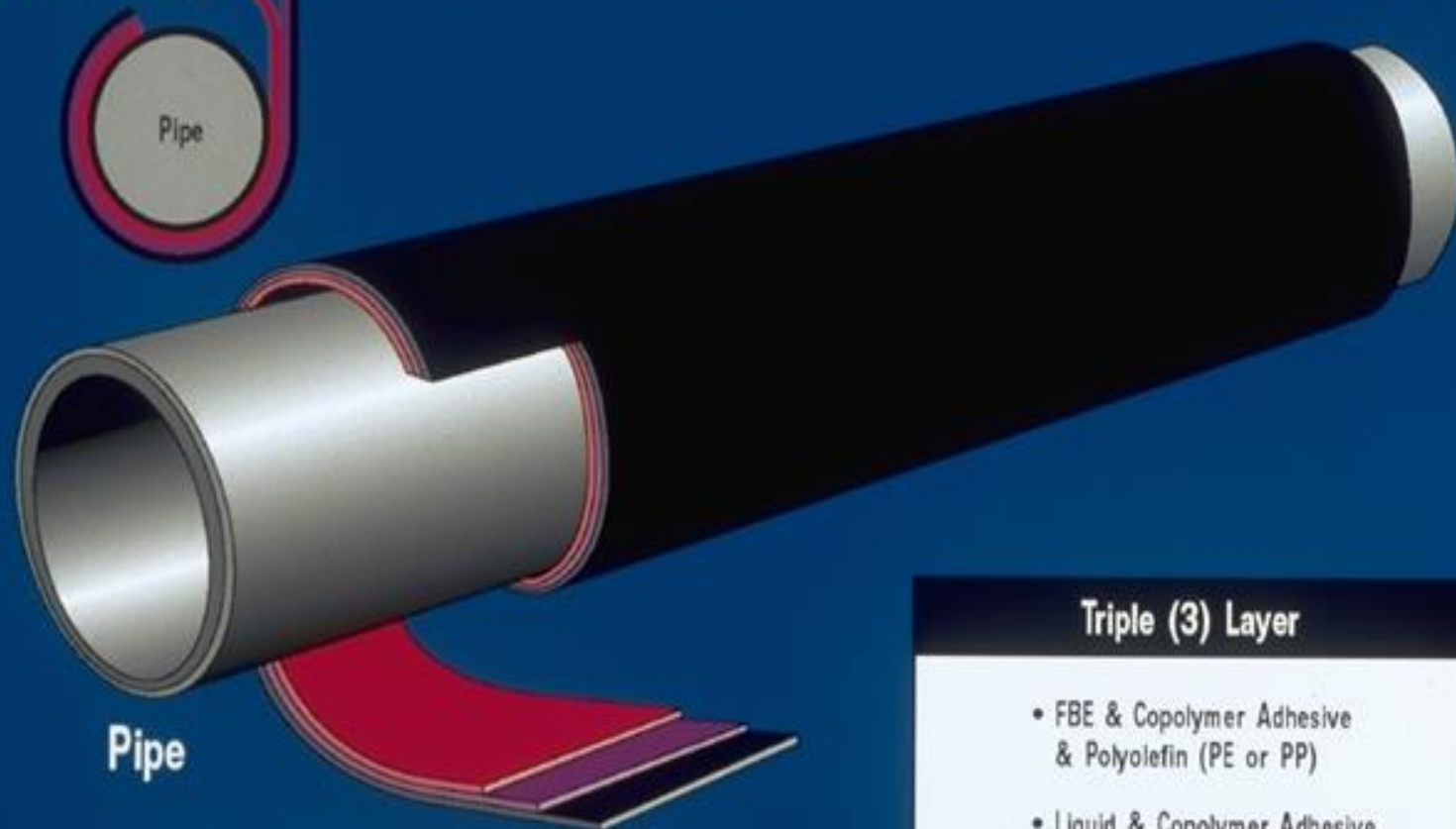
Double (2) Layer

- FBE & Polyolefin (PE or PP)
- Butyl & Polypropylene (PE)
- FBE & FBE
(Abrasion Resistance)
- FBE & Liquid Coatings
(Abrasion Resistance)
- Cold Applied Polyolefin Tapes

Triple (3) Layer Pipeline Coating



3rd Coat →
2nd Coat →
1st Coat →



■ 1st Coat ■ 2nd Coat ■ 3rd Coat

Triple (3) Layer

- FBE & Copolymer Adhesive & Polyolefin (PE or PP)
- Liquid & Copolymer Adhesive (PE or PP)



SURFACE PREPARATION

SURFACE PREPARATION

PURPOSE OF SURFACE PREPARATION

- ***To clean surface of materials which could cause the coating system to fail prematurely.***
- ***To provide a surface that can be easily wetted for good coating adhesion.***
- ***To provide an anchor profile.***
- ***Paints adhere to the surface by mechanical bond.***



TOO LOW



1-2 MILS

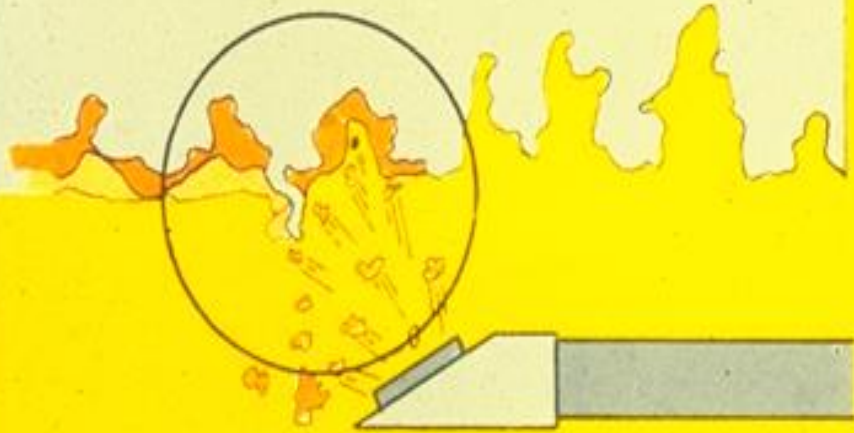


GREATER THAN 2 MILS

ANCHOR PATTERNS

Anchor Pattern Formation

Before



After

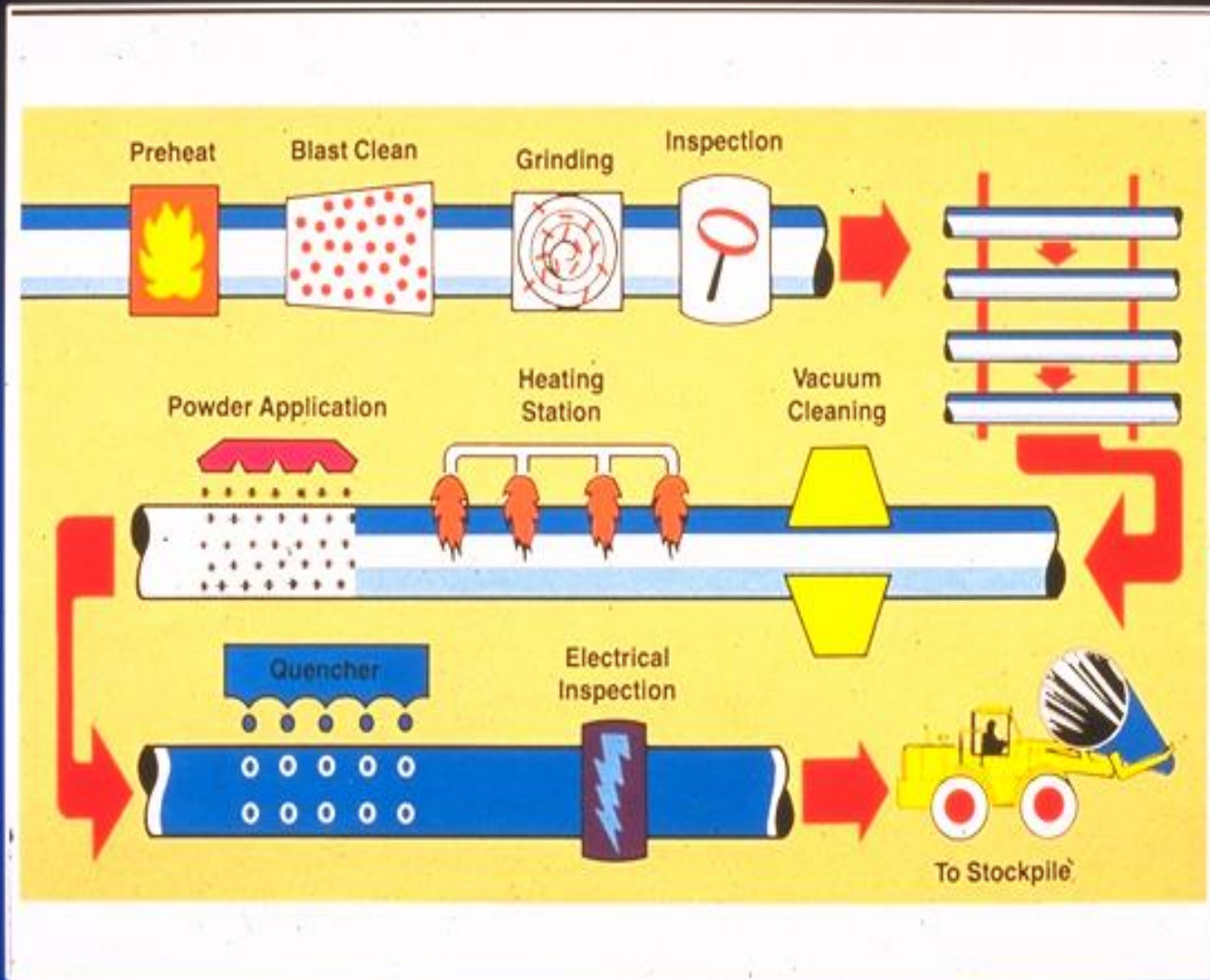


FUSION BONDED COATINGS

APPLICATION PROCEDURE

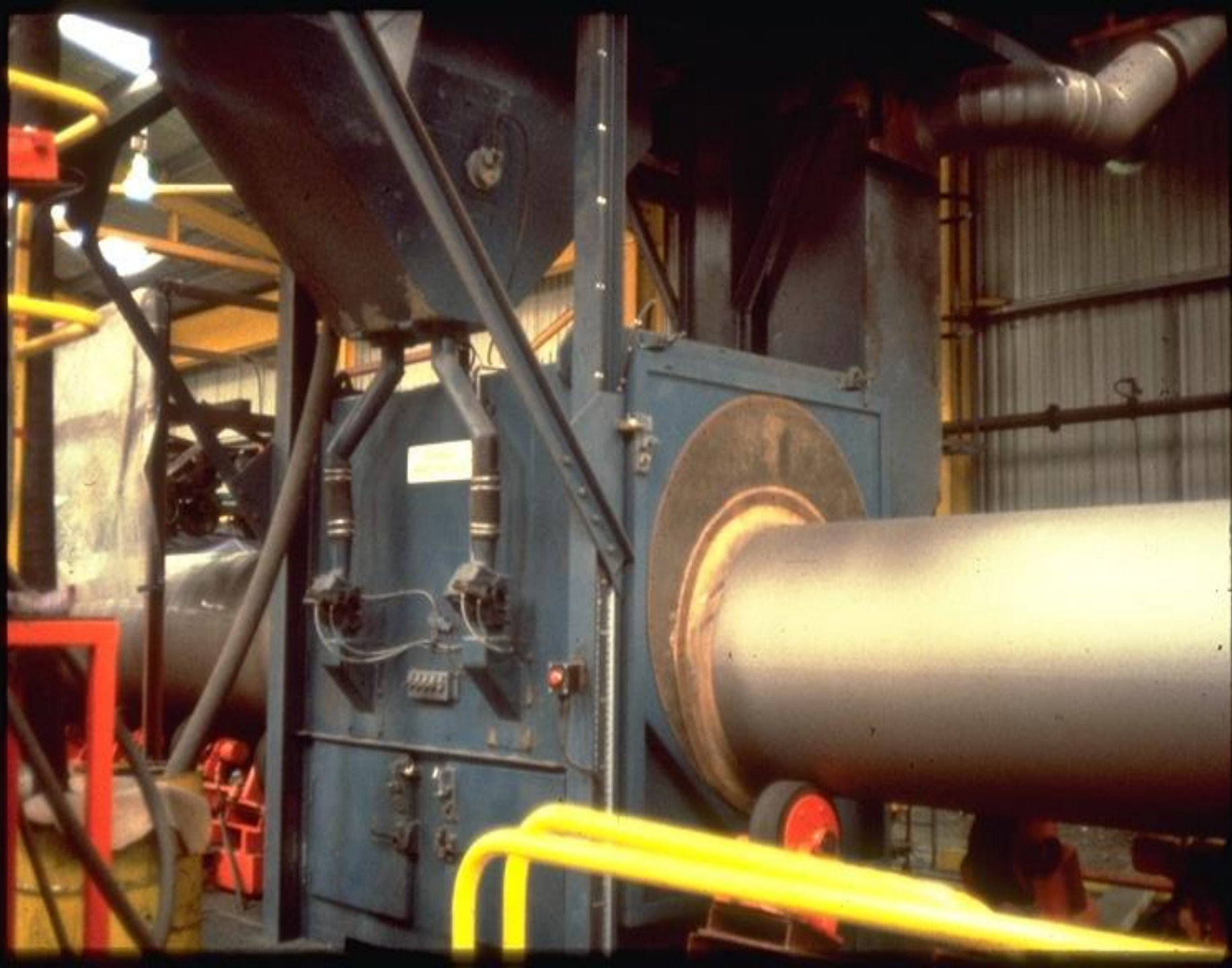
- 1. CLEAN**
- 2. HEAT**
- 3. APPLY**
- 4. CURE**
- 5. INSPECT**
- 6. REPAIR**

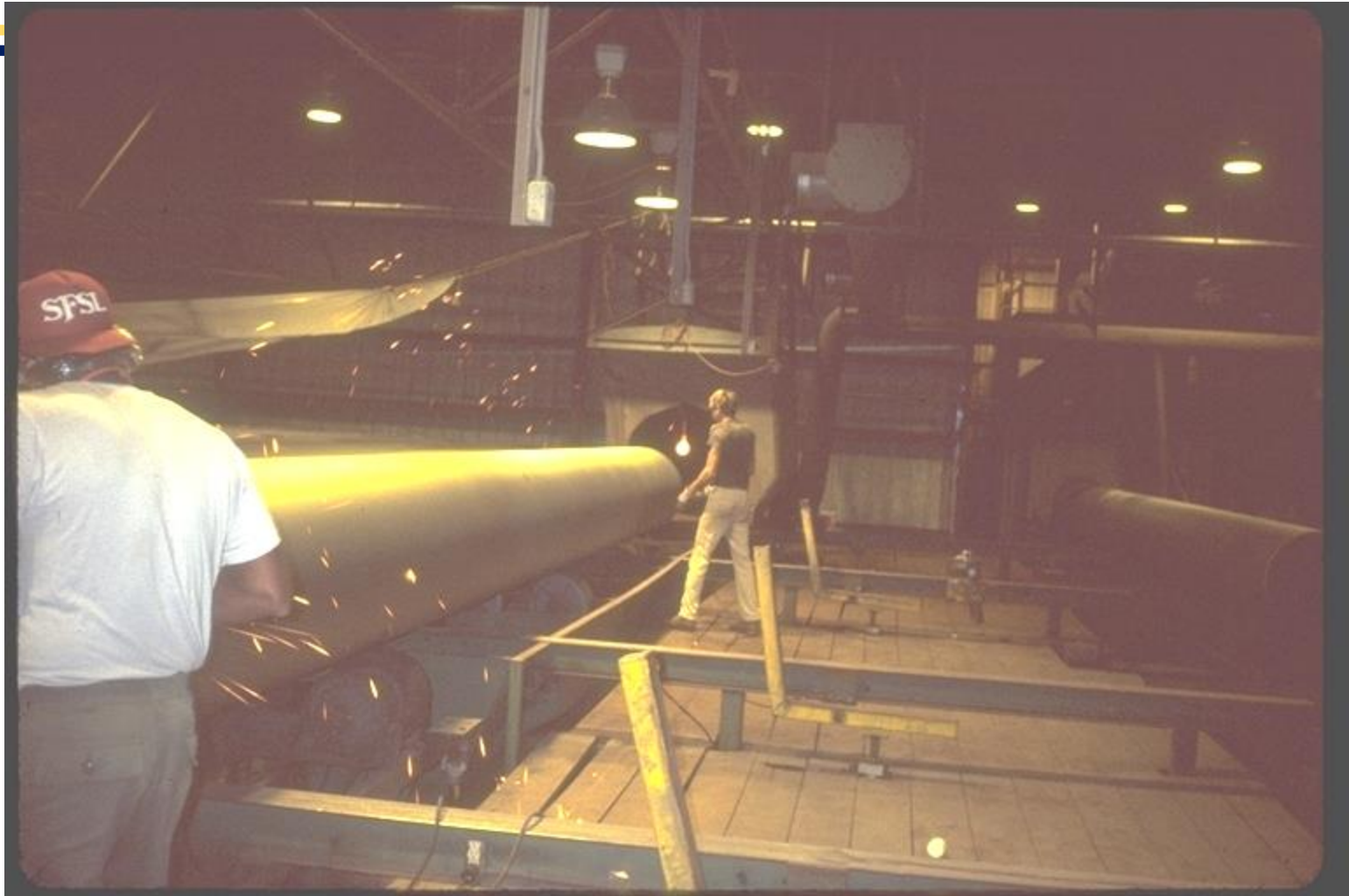
Fusion Bonded Epoxy









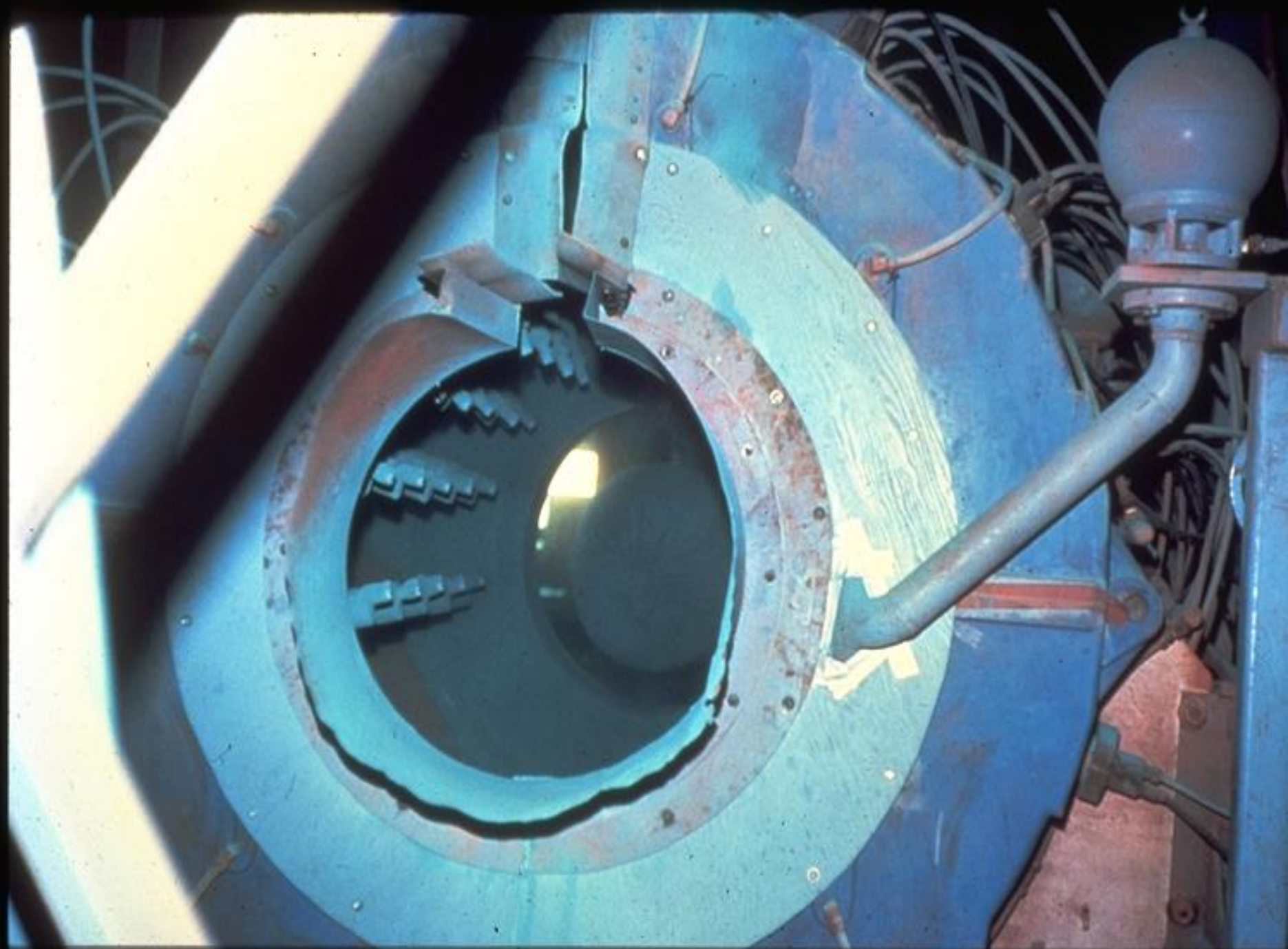




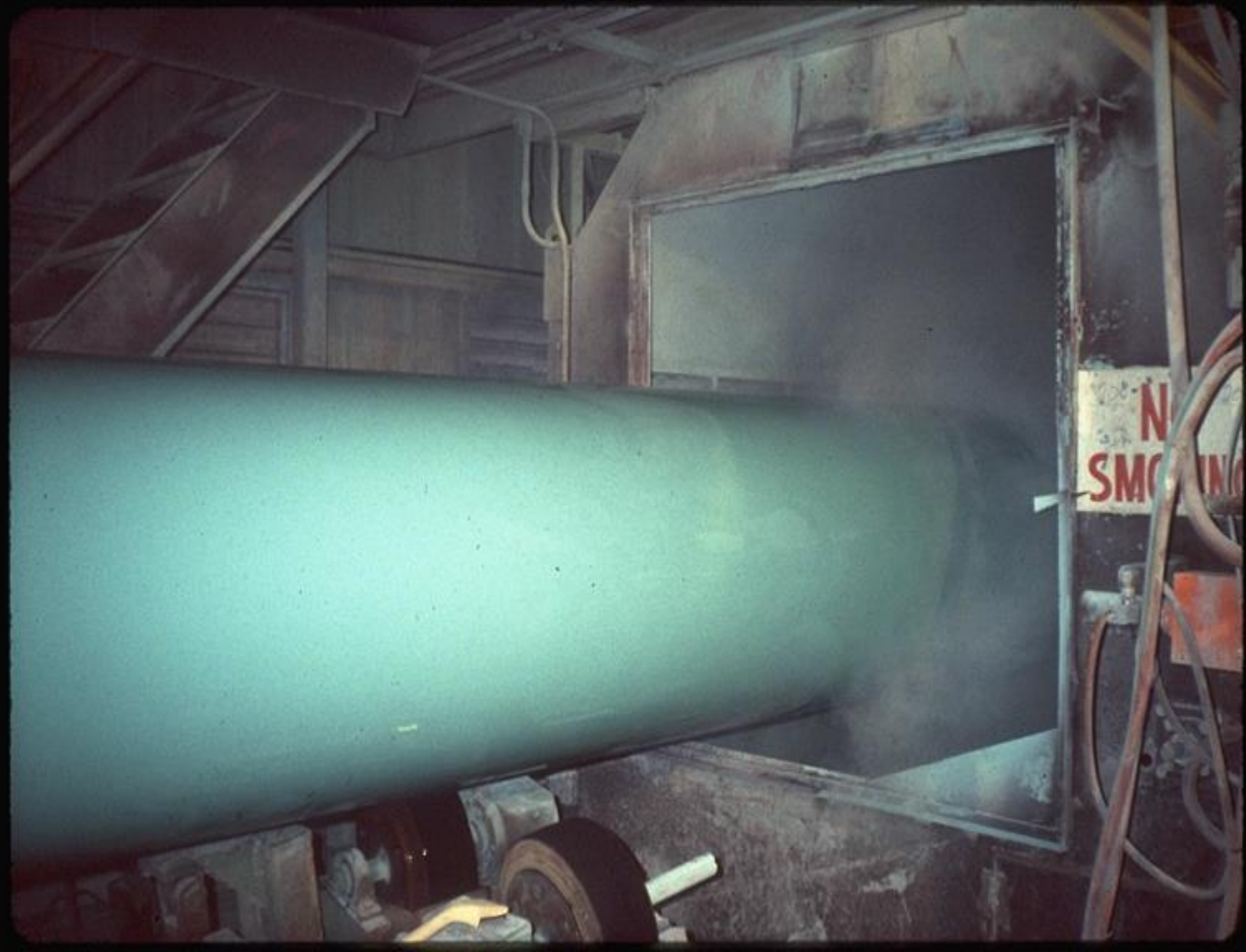




ER
OR OPEN
AREA

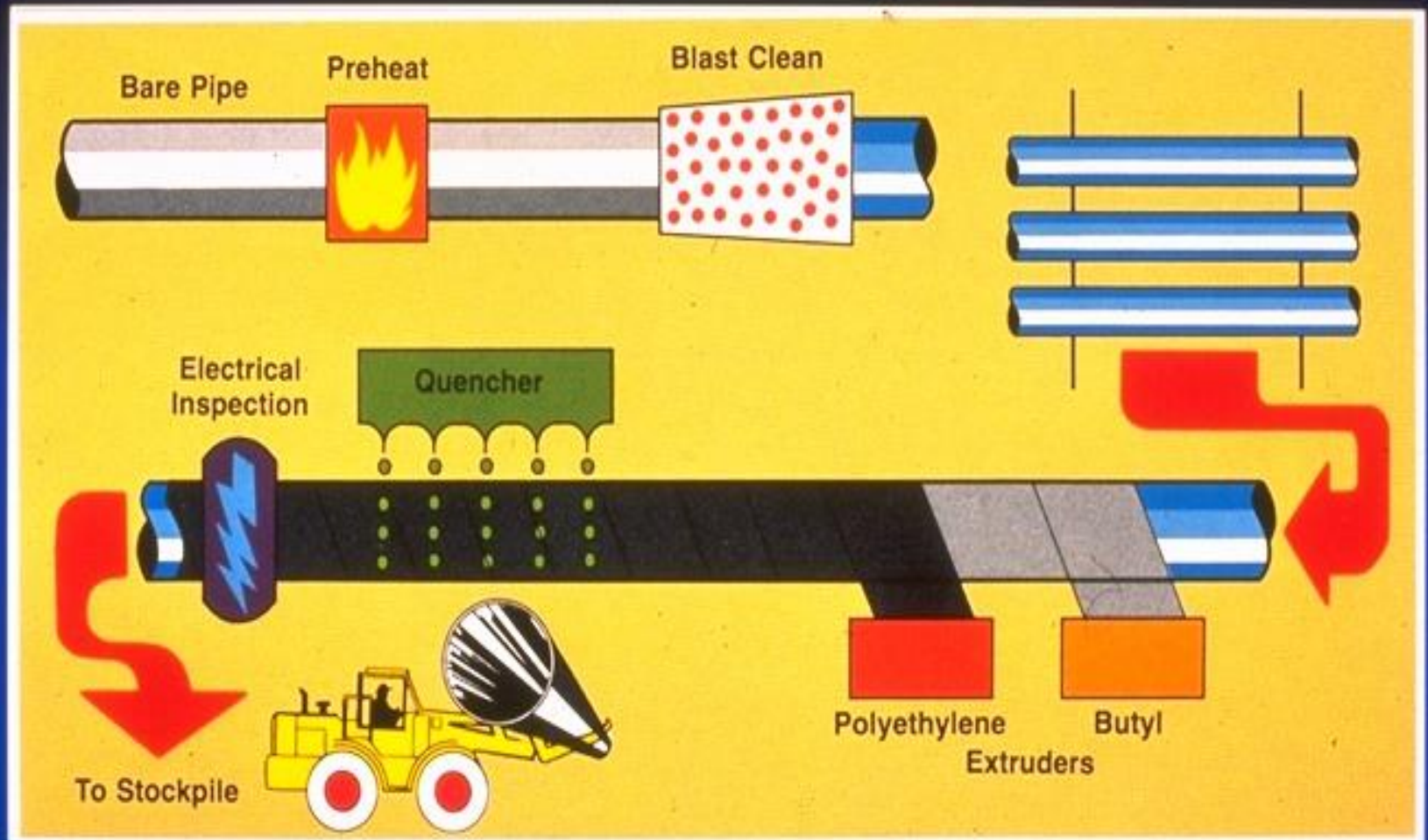






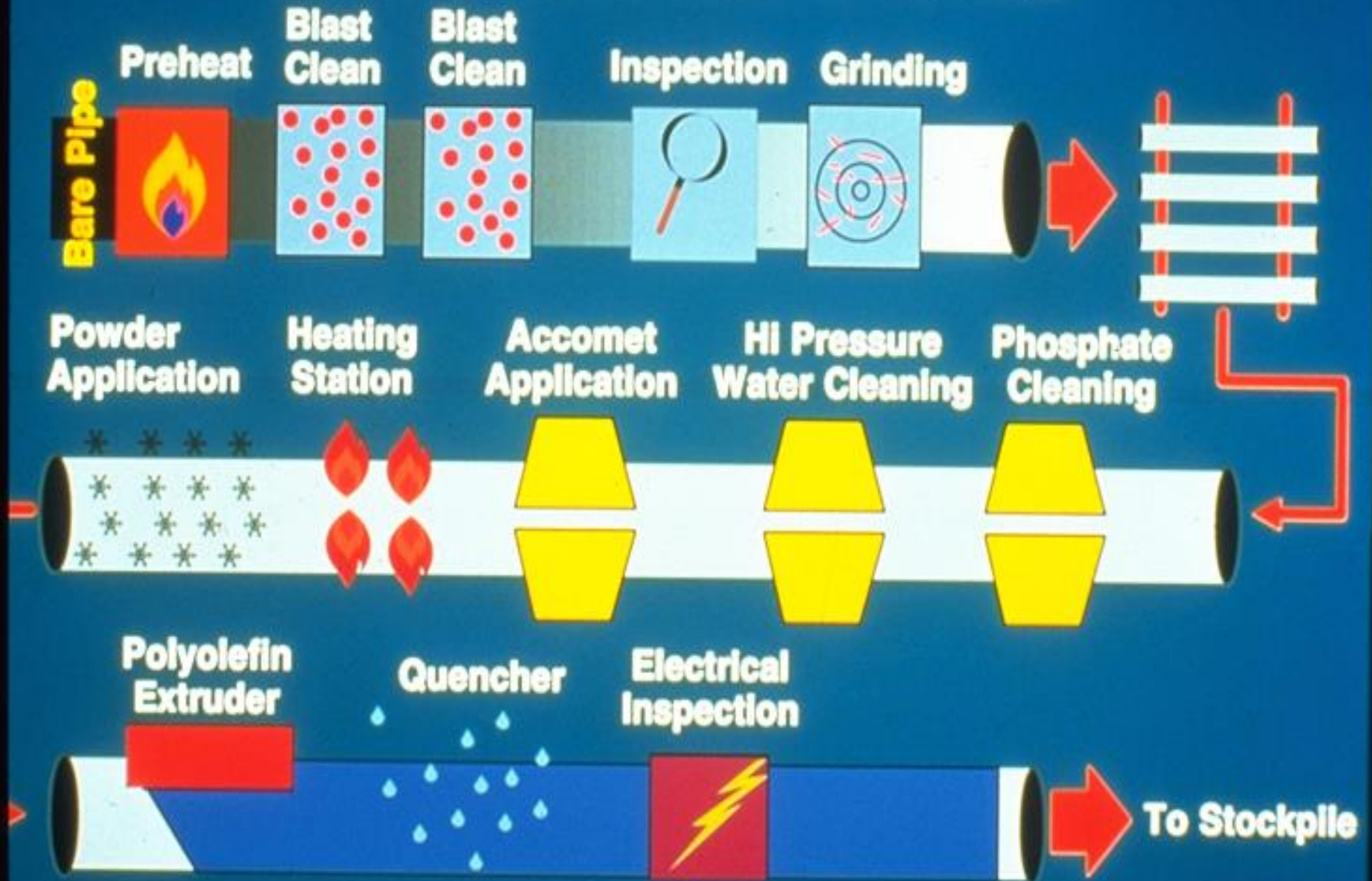
NO
SMOKING

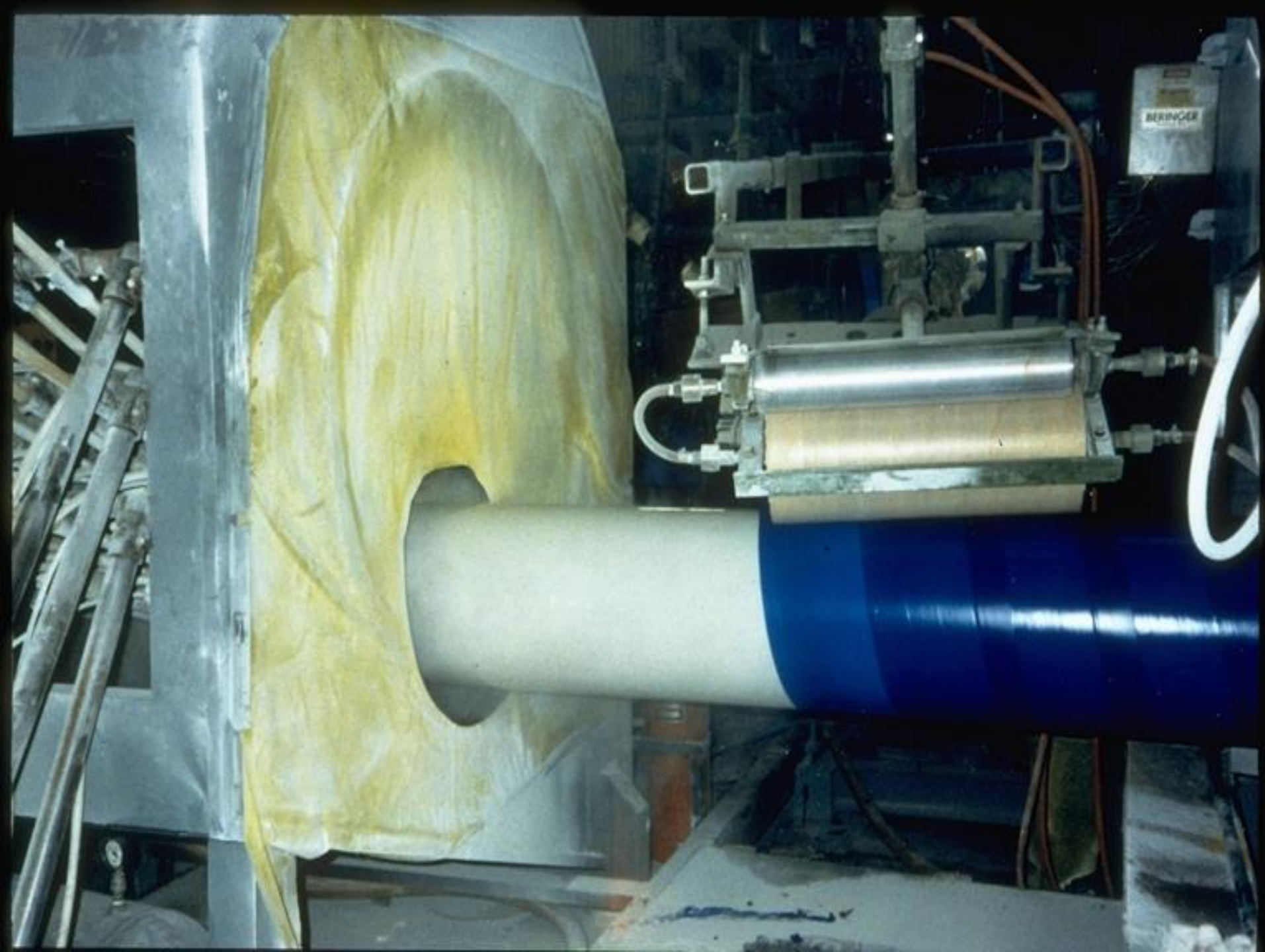
PE/BUTYL (Two Layer)



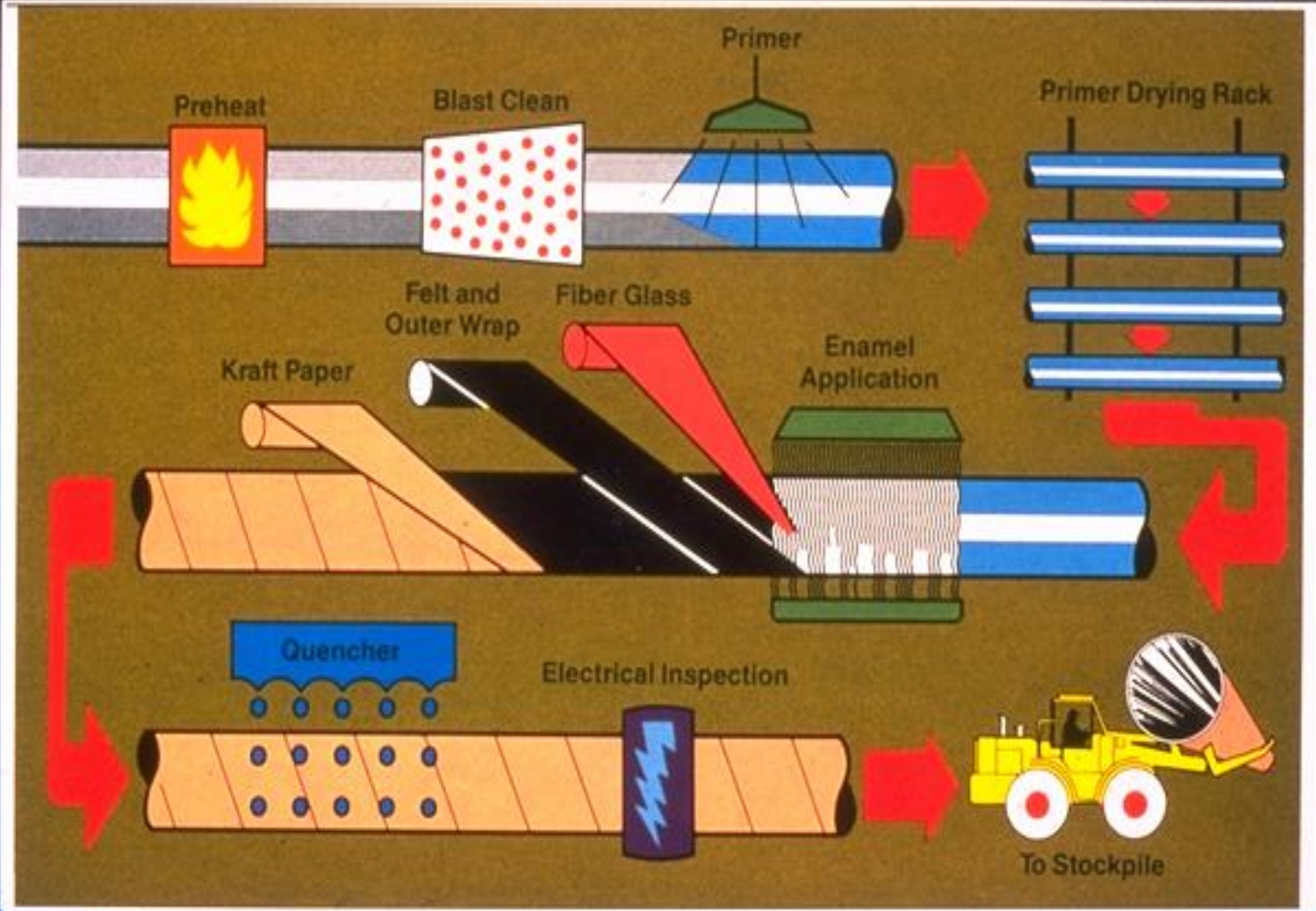


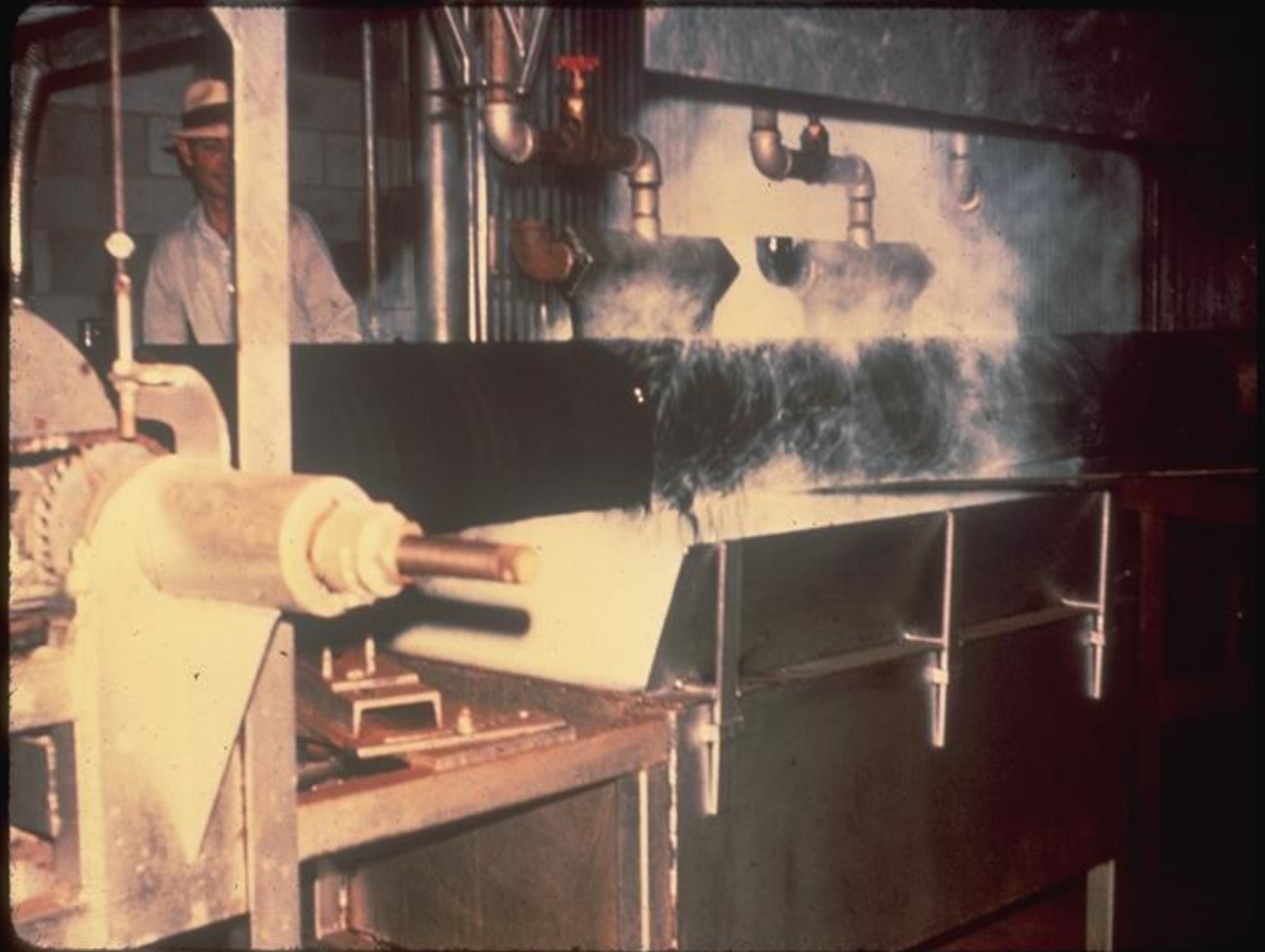
DUVAL COATING SYSTEM

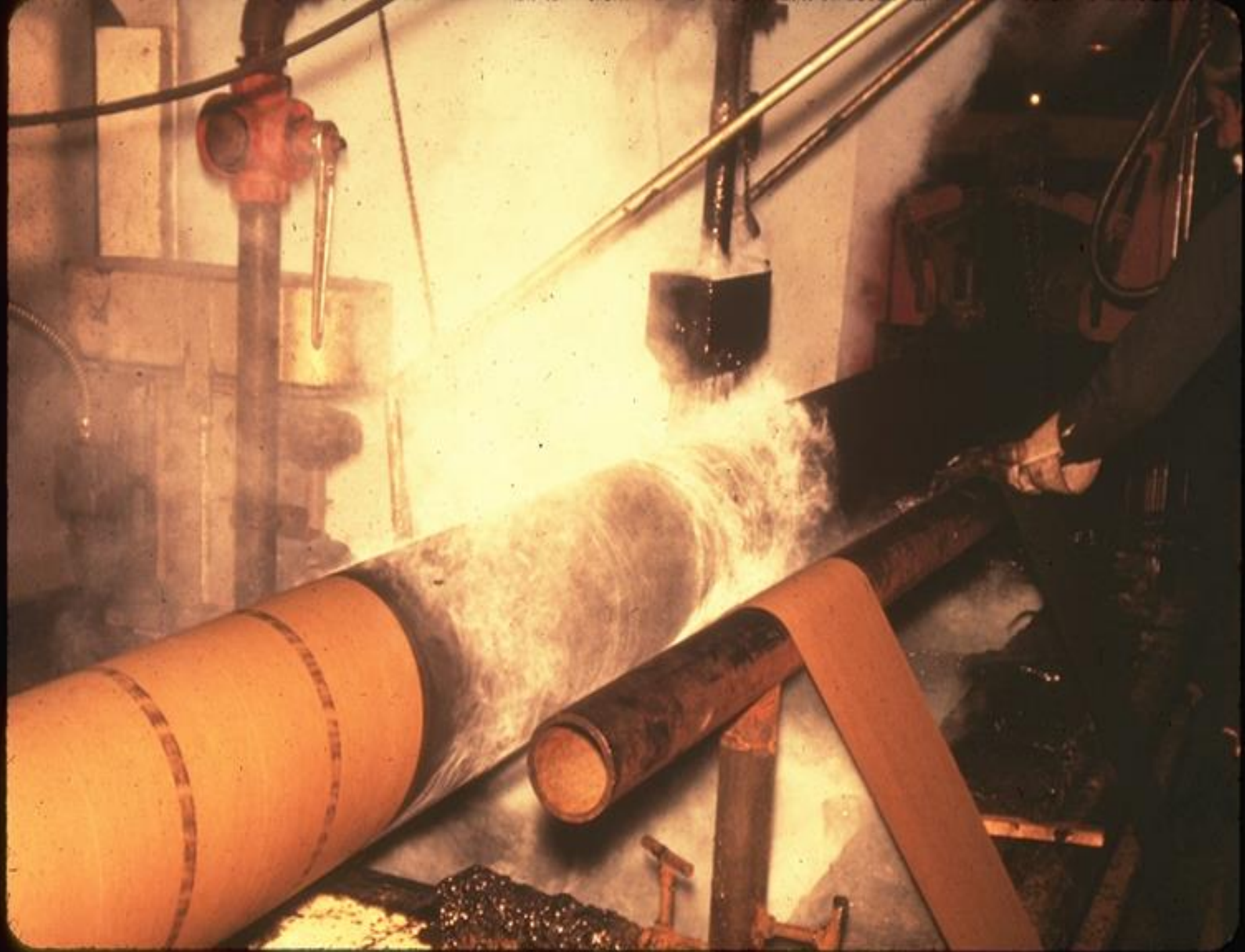




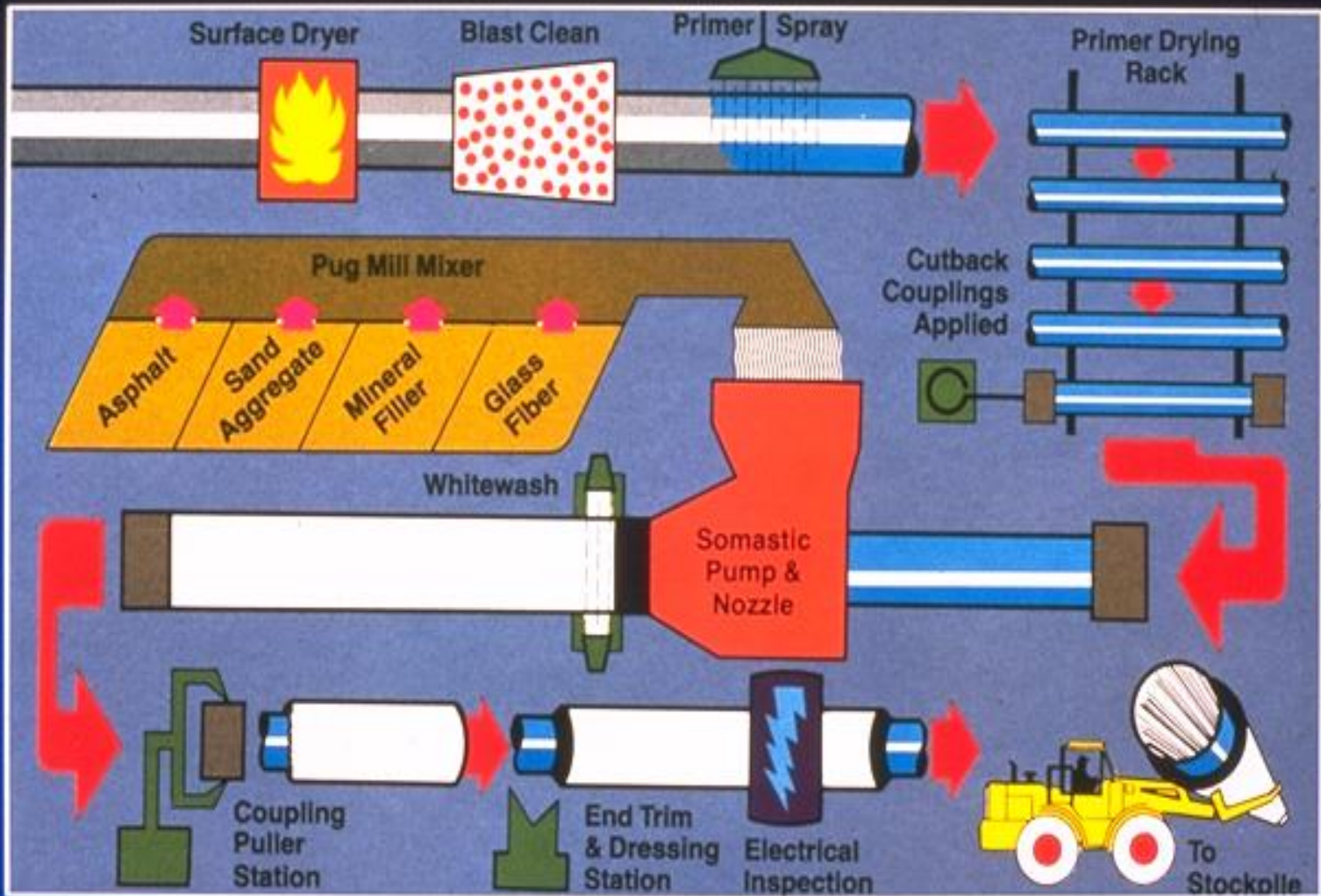
Coal Tar Enamels

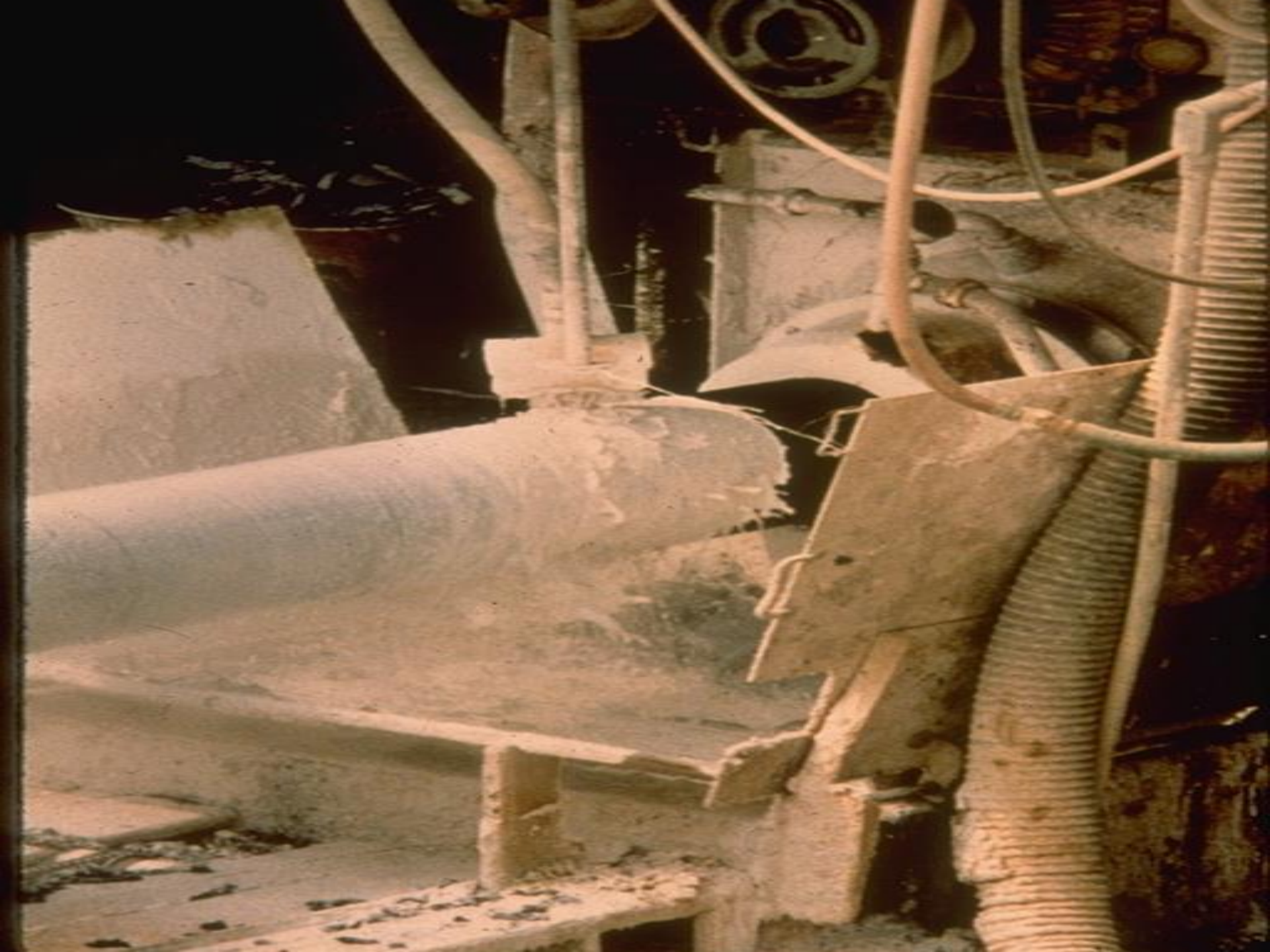


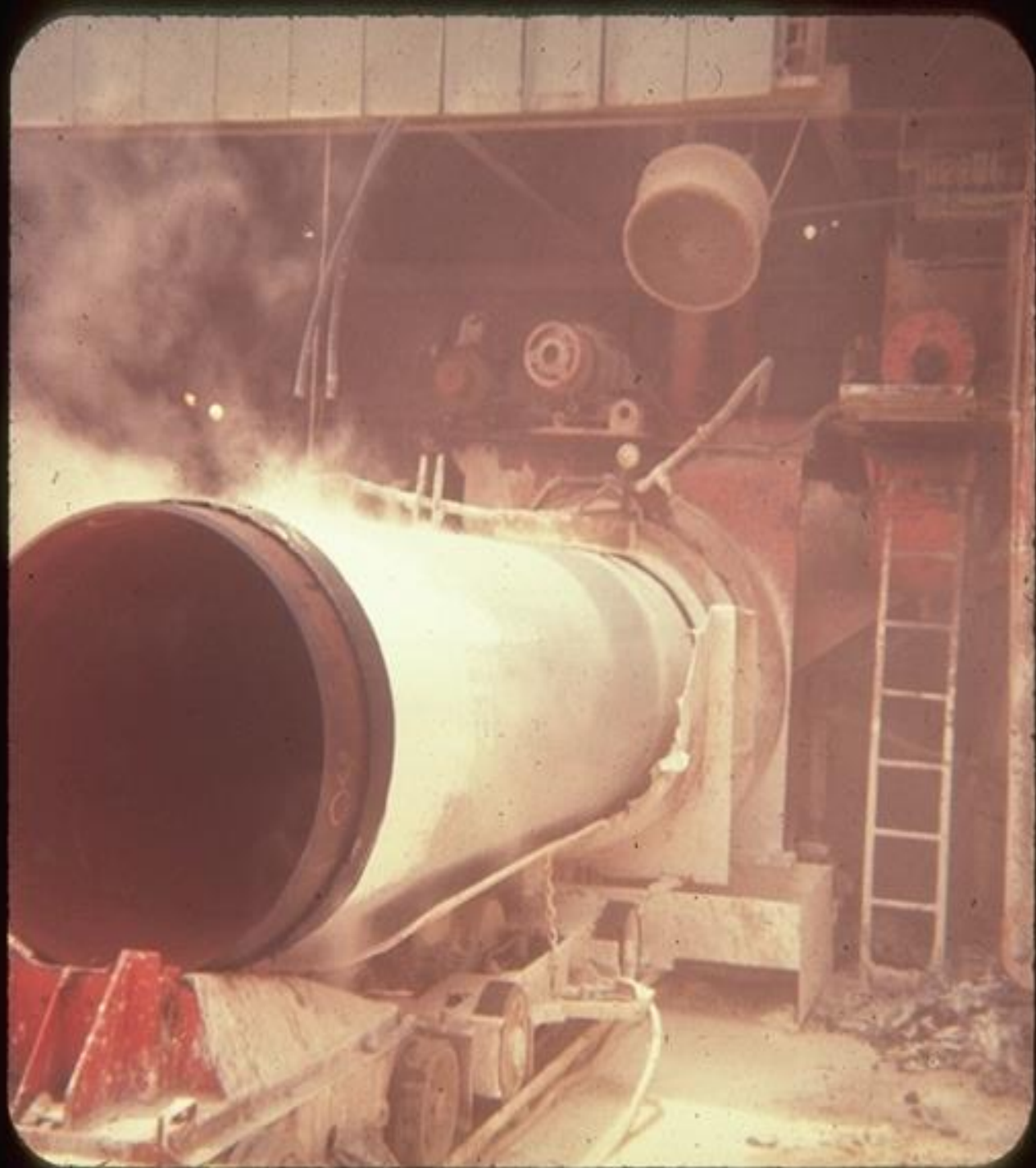




Asphalt Mastic



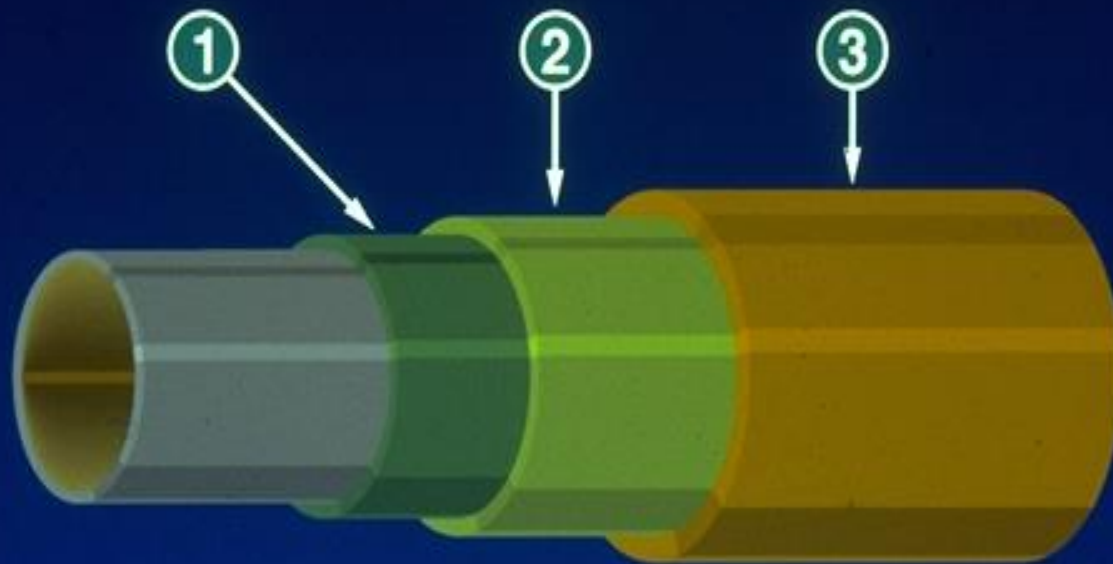






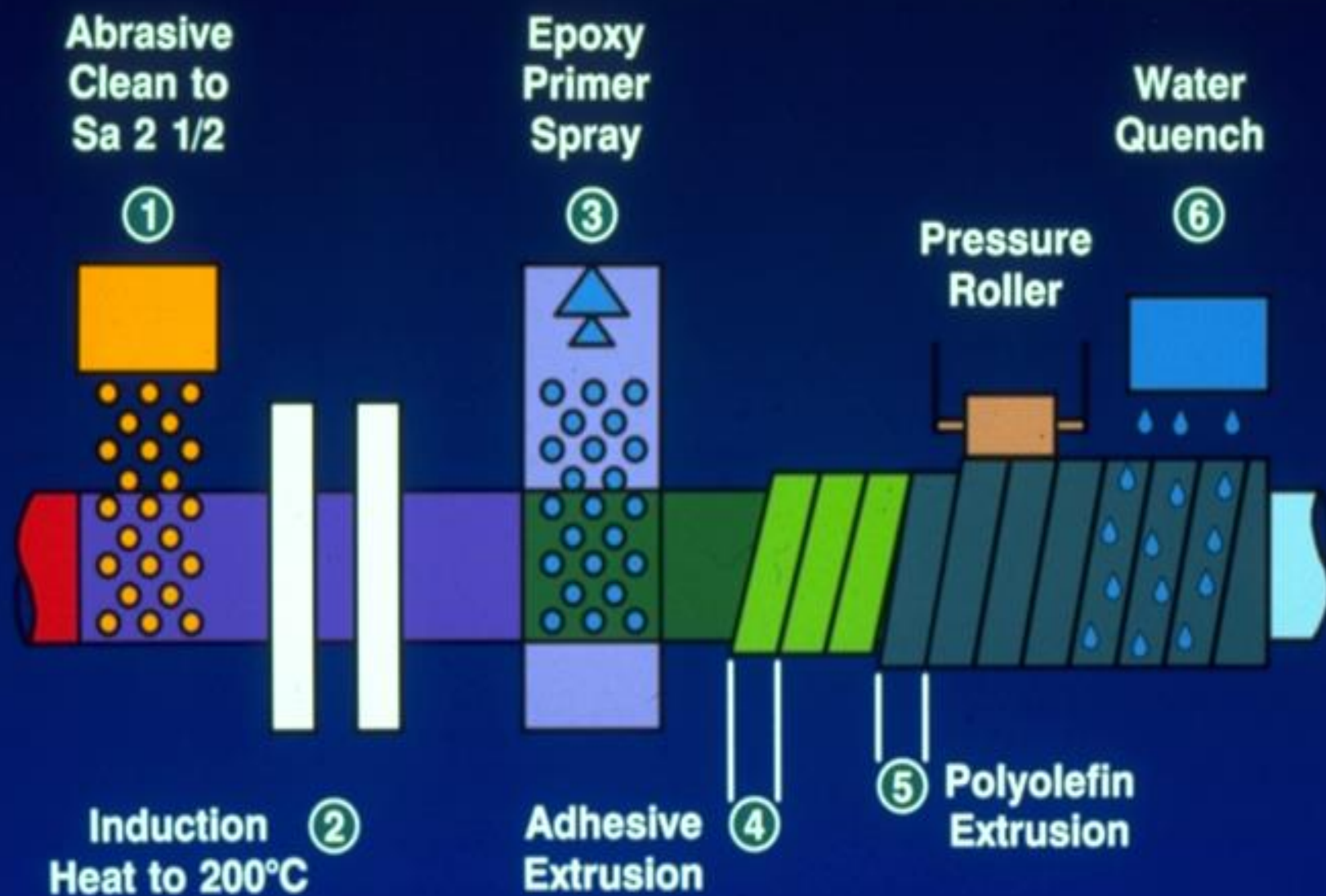


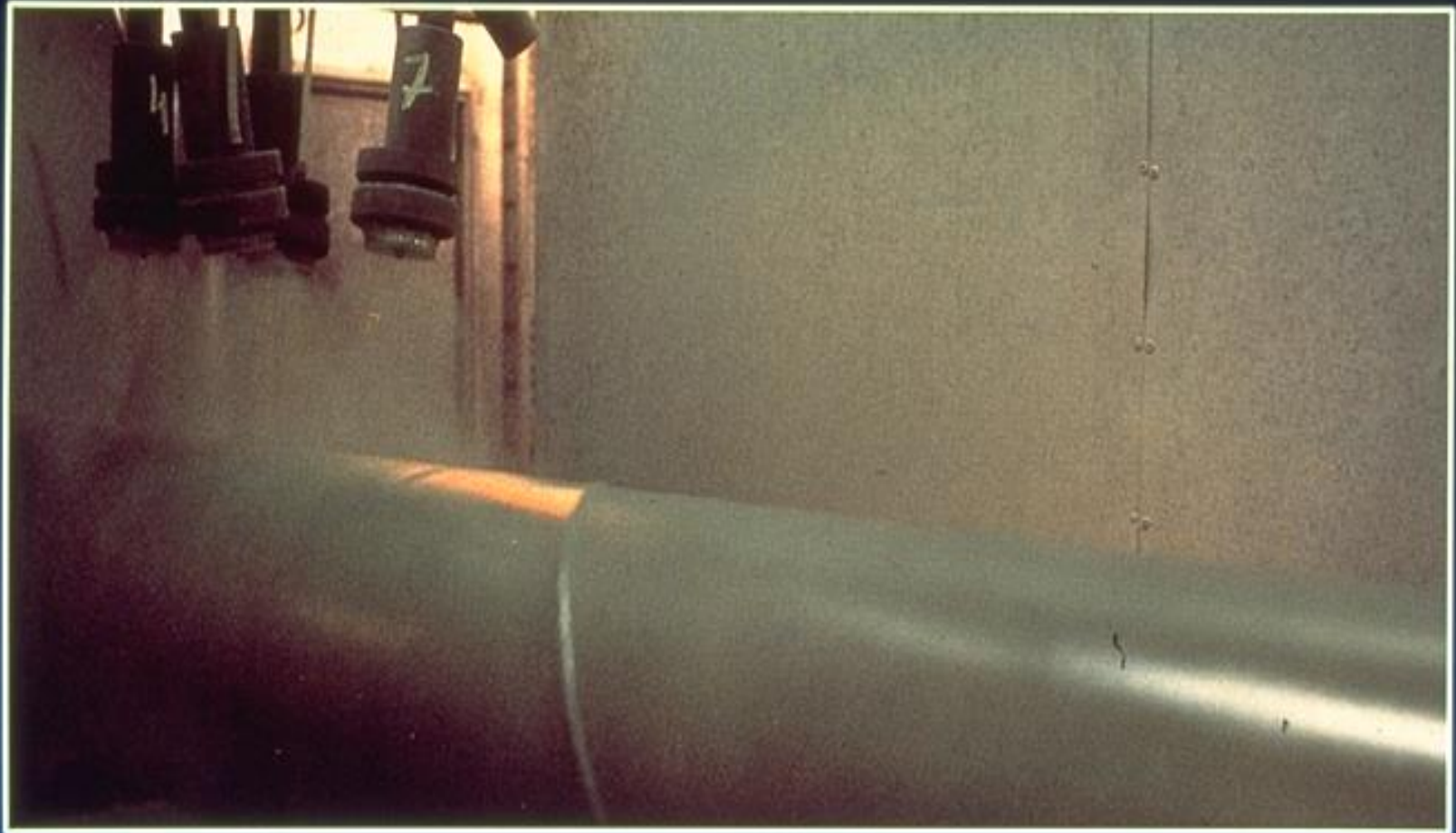
**Figure 1 Shows a Schematic Diagram of a
Typical 3-Layer Pipe Coating**



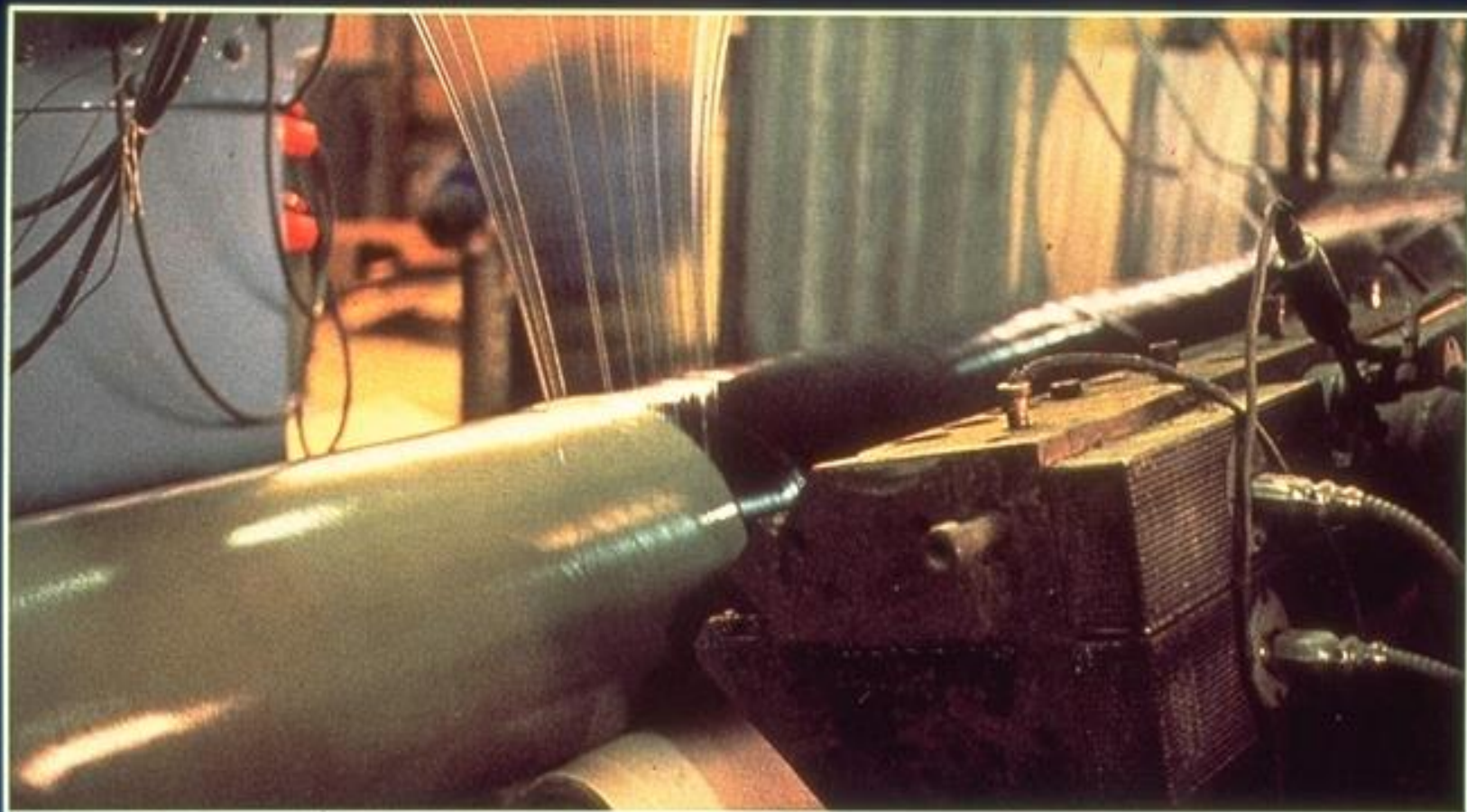
- ① EPOXY PRIMER**
- ② INTERMEDIATE ADHESIVE LAYER**
- ③ POLYOLEFIN TOPCOAT**

Schematic Diagram of 3-Layer Pipe Coating



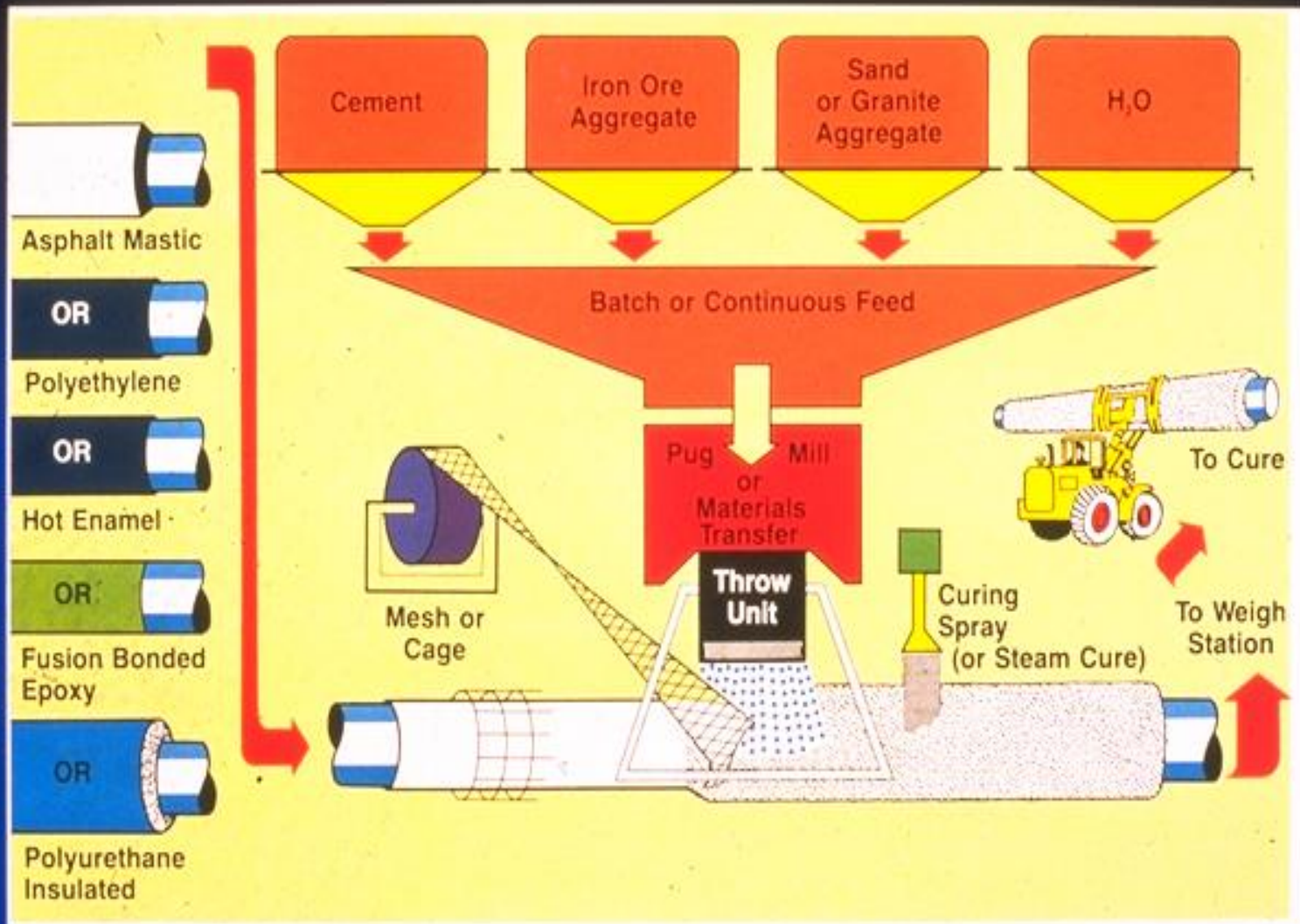


Application of EUROKOTE Epoxy Powder Primer Layer

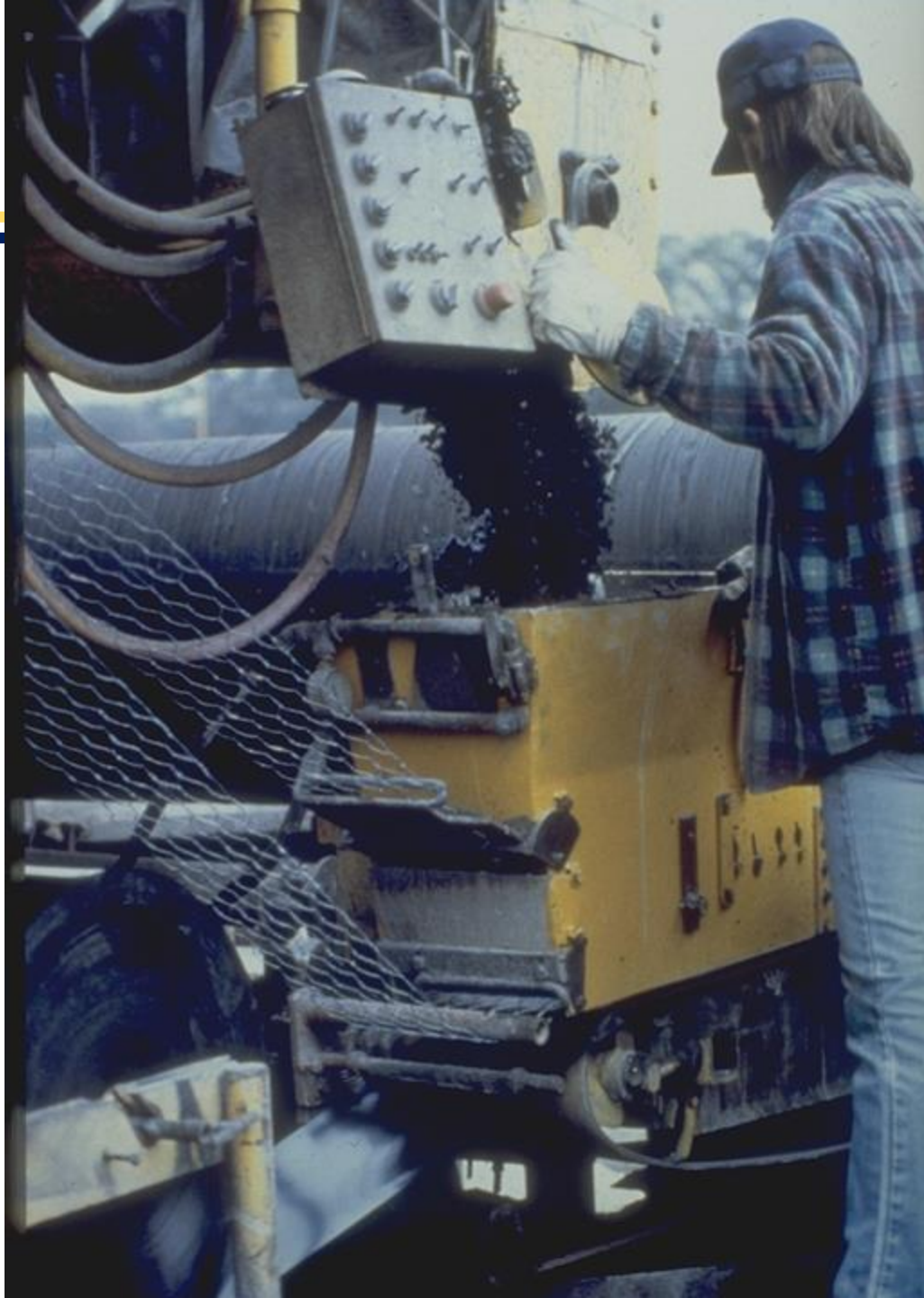


Extrusion of Adhesive and Low Density Polyethylene Over the Epoxy Primer Layer

Impingement Concrete Coating



















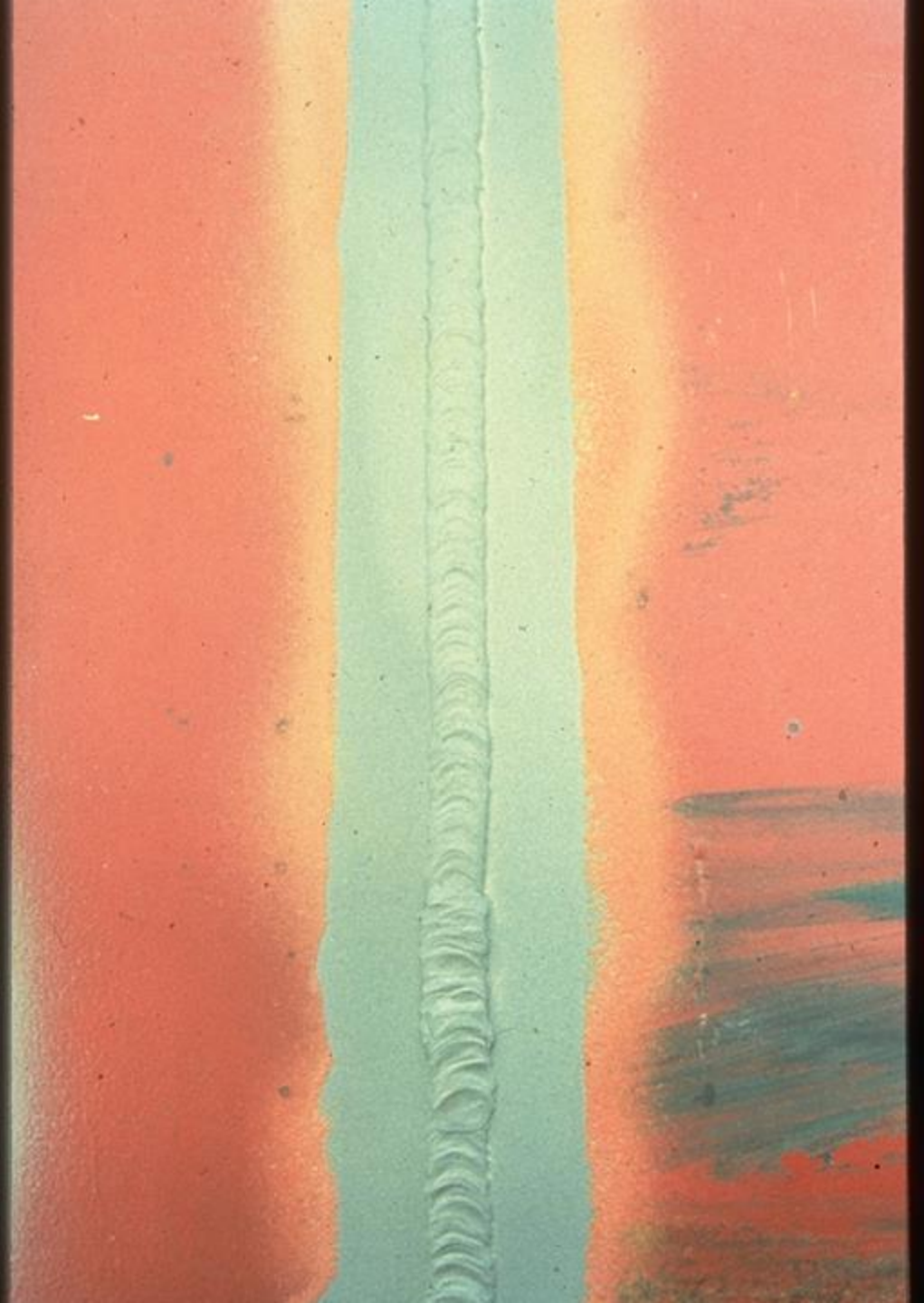










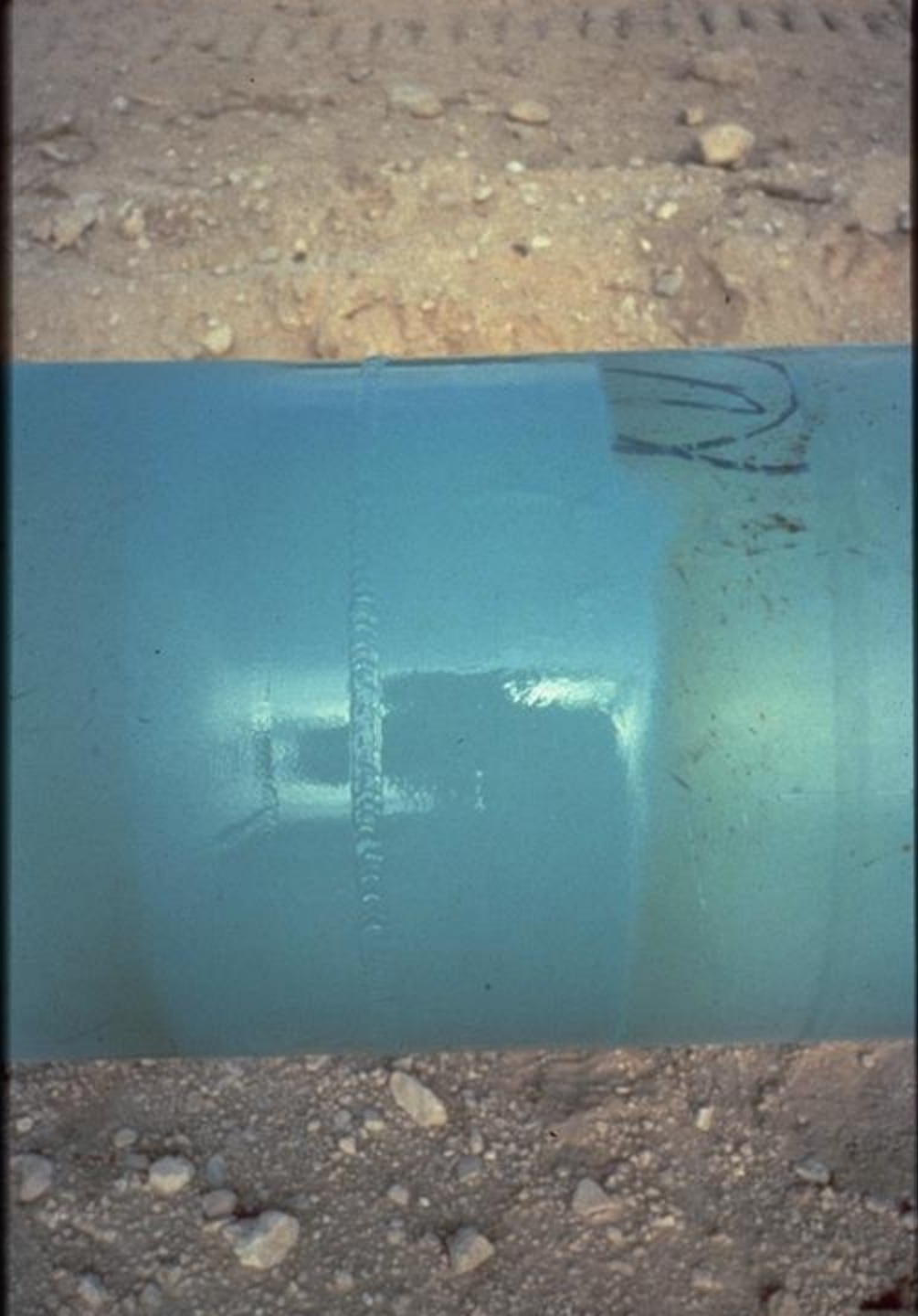


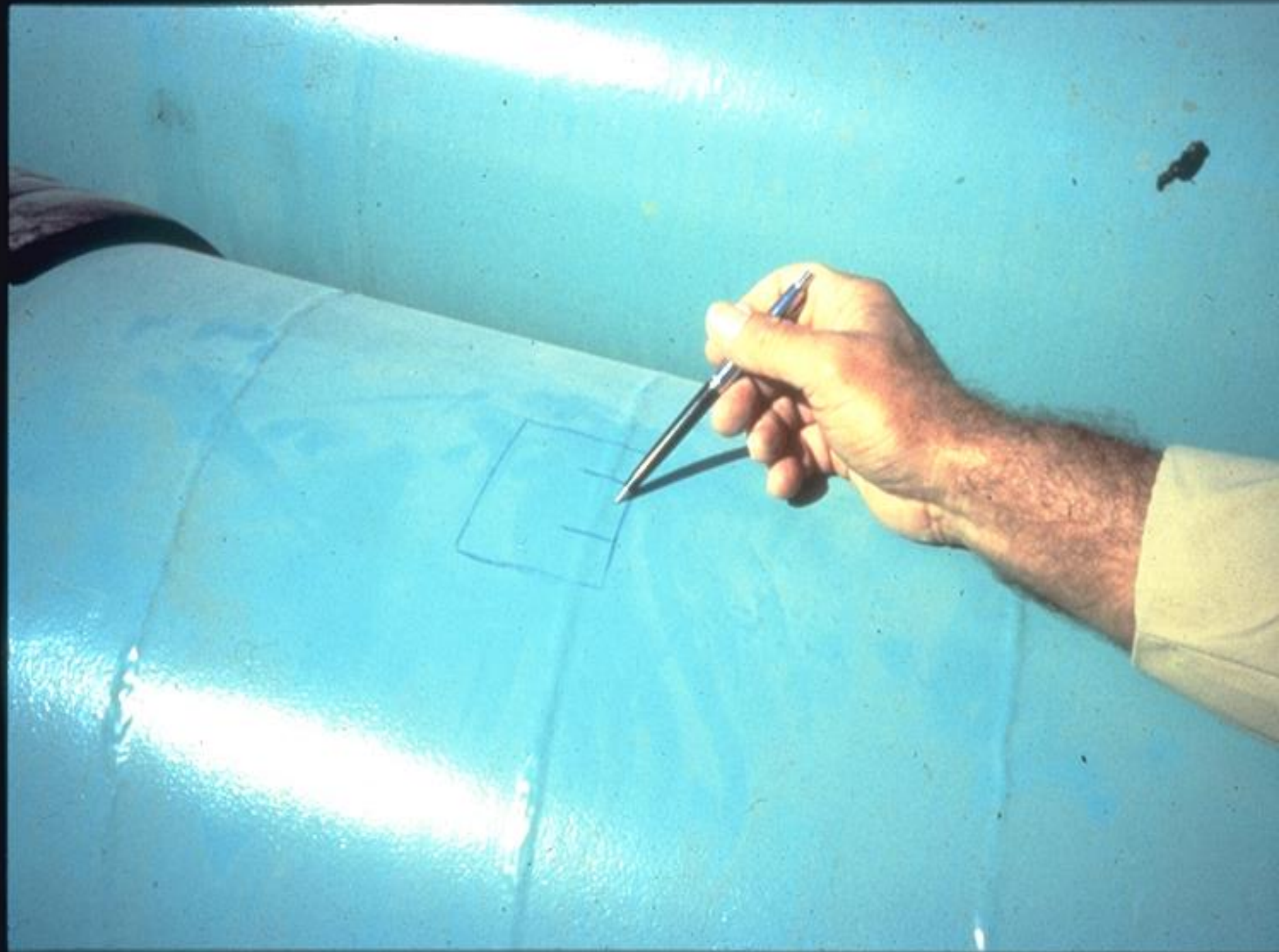
















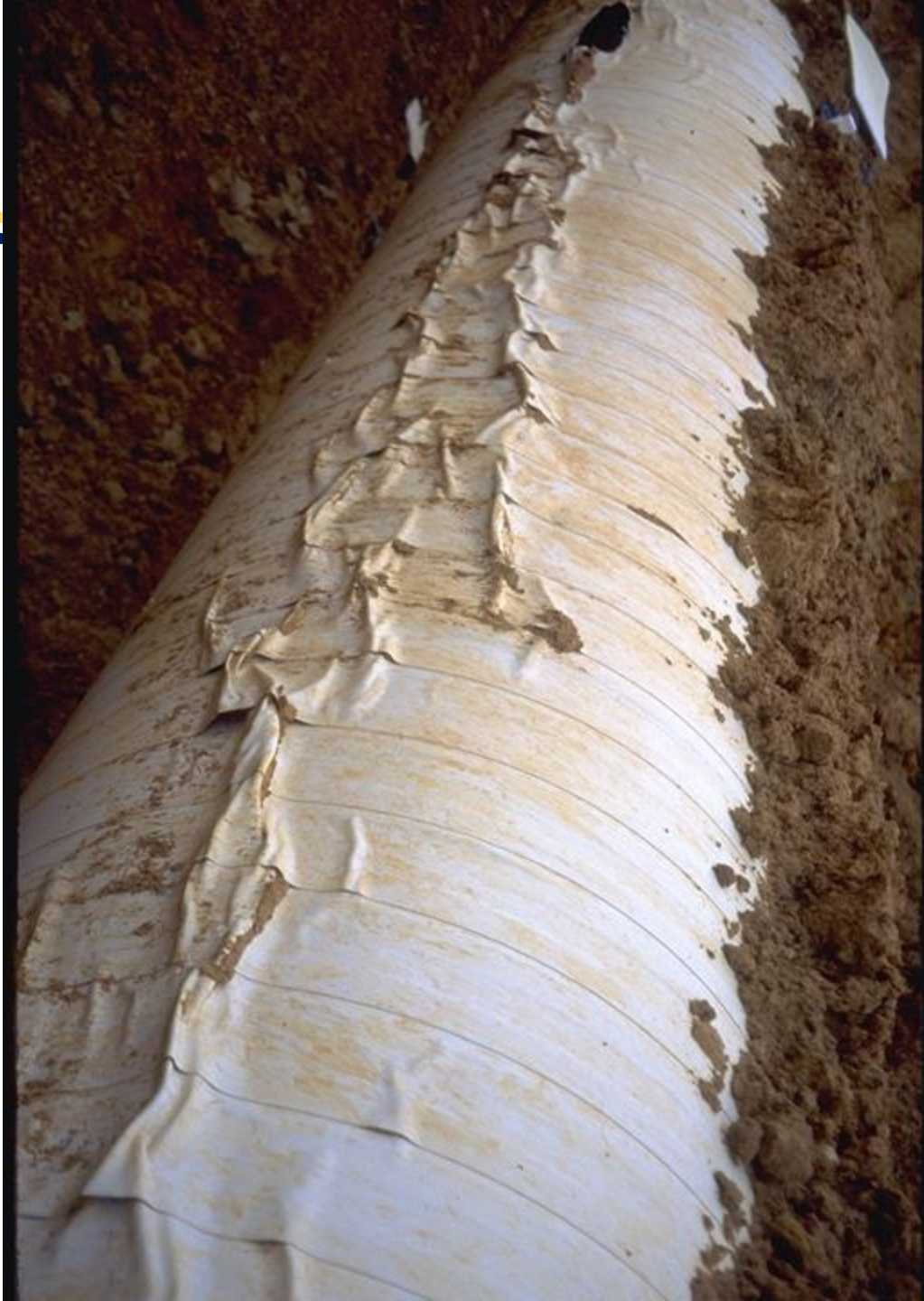
























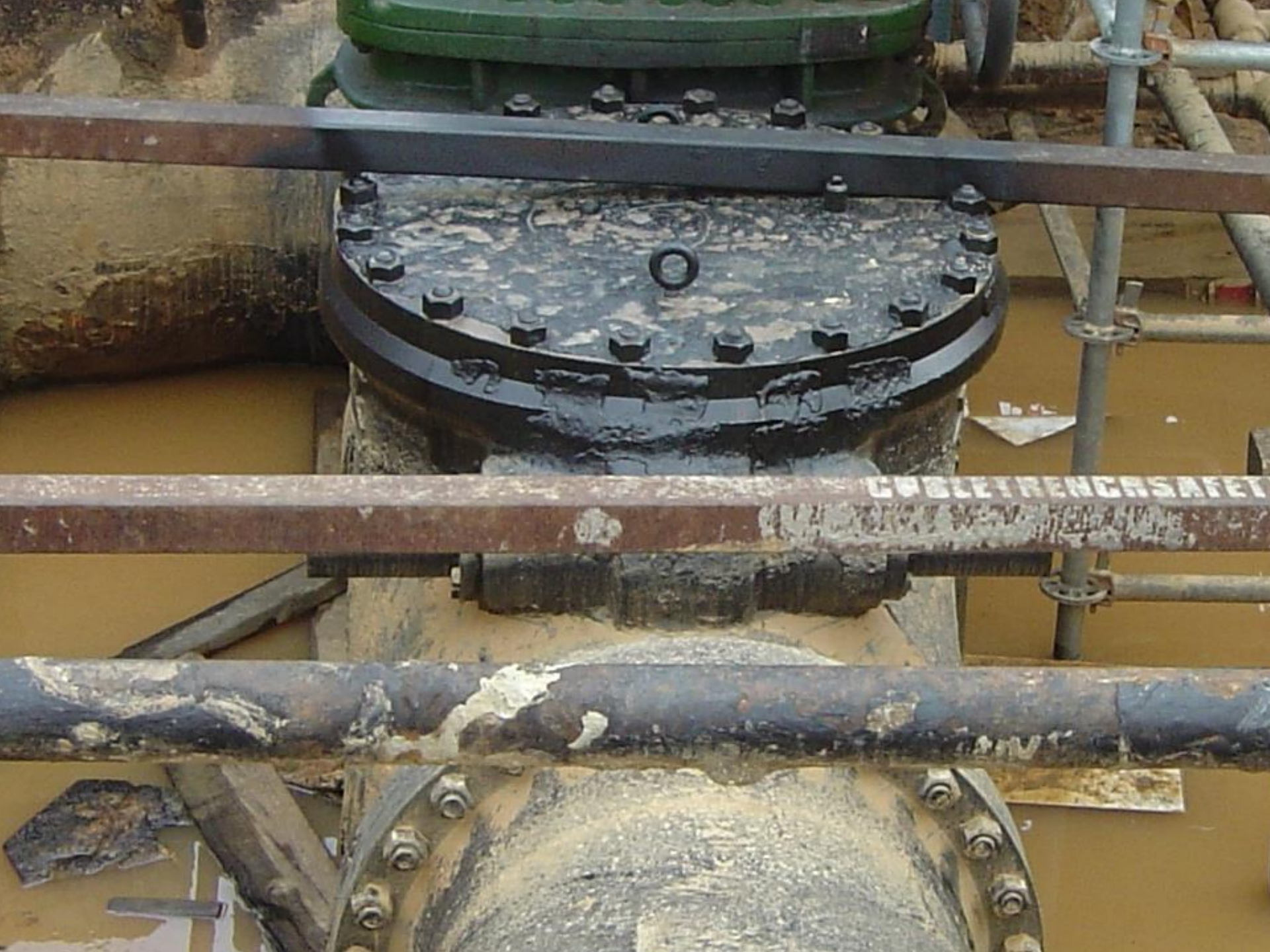




















The End!

- **Questions?**