

3.37 (Class 18)

Review

- Oxyfuel cutting eliminates the boundary layer by formation of liquid oxide
- Fe is the fuel in any oxyfuel cutting: C₃H₄ and C₃H₈ do not limit productivity
- Oxyfuel cutting speed can be decreased by 50% or more due to high carbon in the steel or nitrogen in the oxygen
- Stainless steels cannot be flame cut, sometimes add iron powder to the oxygen flame to enable a ragged cut in stainless steel.

Today

How to cut thick aluminum

- Had a call, with aluminum about 1.5' thick, inside a melting pot, lost power and the aluminum solidified in the pot. Plasma torch can't cut very deep. Talking later with an Alcoa person and asked about how handle this problem. A person in Pittsburgh (the "Red Adair" of frozen aluminum pot lines). Drill holes, put charges in, and blow it. Sometimes works, sometimes doesn't.
- In steel mill, "tapped the heat", poured 200 tons of steel onto the open railroad tracks. With this you can flame cut.

Cast iron, many types, malleable iron, good ductility, 24-48 hours to do this in the furnace, can put Mg in liquid iron, get spherulites (sp?), "nodular iron" or ductile iron, all cast iron sewer pipe is nodular iron, problem is that Mg doesn't alloy highly with the iron, if it isn't added the right way then can blow liquid cast iron all over the foundry.

Bethlehem now filing for bankruptcy. Seeds sown in 70's. Chairman of Bethlehem "the Japanese aren't using anything we don't know about". Making a fortune at that time and burning money. Taking care of their execs. When looking for a job, look to see if the company has assigned parking spaces, and how many. Management should serve the workers, not the other way around.

Kodak in 60's asked Japanese if could build a film plant. Japanese didn't say no, but stonewalled, Fuji built a plant and was able to eventually take over this market. Visited Kodak in early 90's. Had to hide their profits, so instead of standard variety conveyor system, had a custom built stainless steel conveyor system. No longer have this problem.

How to get through MIT

- All need to remember about the previous lecture is just a few basic bullet points.
- "Education is what remains after everything else is forgotten"
- Don't have to know much about a subject to do well in school
- Professor often tries to hide the outline of topics
- Furiously take notes and never really get the two or three key points

- Typical teaching technique in universities
- Professors usually only test on the high points, can usually psych out the quizzes

Arcs are electrically augmented flames

- Can get $10,000 \text{ W/cm}^2$
- Diagram of electrode
- Have a boundary layer, but electrons punch right through it, 90% of heat this way.
- 99% of the current is carried by the electrons, other 1% carried by the ions
- Take a neutral gas, separate into positive and negative charges electrons move about 100 times as fast as the ions

Diagram of arc, plot voltage profile across the arc

- Near the tip of the electrode, called the “cathode fall” region
- “anode fall” region
- plasma column in the middle, have $8\text{-}10\text{V/cm}$, in the fall regions have much greater
- 10-15 volts, say 1cm
- 4-5, 2-4 V in cathode fall, anode fall regions
- relatively cold gas forms a sheath region that doesn’t have many electrons
- composition of argon, at 14000K, have about 50-50 ions, welding plasma typically about 5%-20%
- Plasma temperature naturally controlled since the system wants to carry the current, about 10,000K arc, up the current get a slight increase in temperature, 50K is enough to double to current