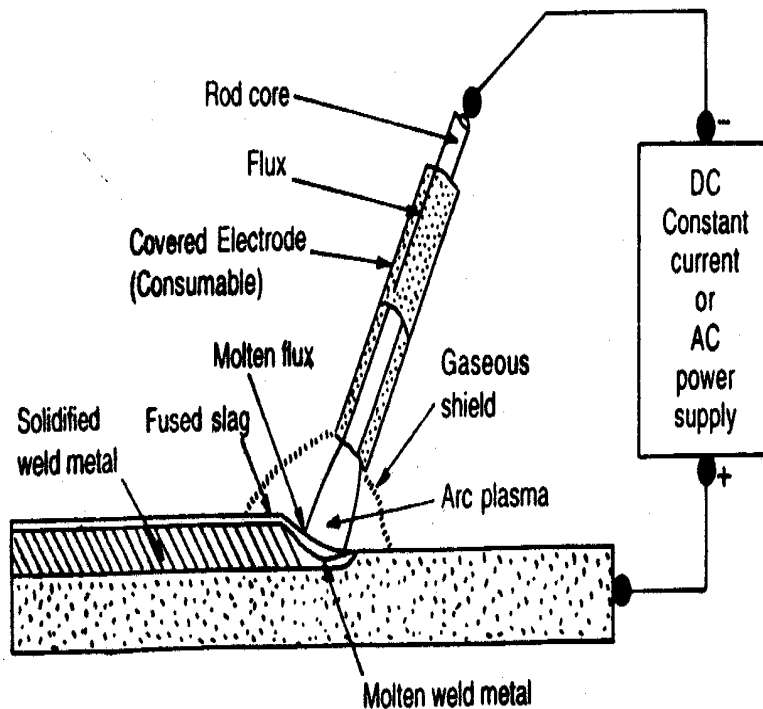


# **MMAW - PROCESS**

Presented by:  
L.SUNDAR



# Principles of MMAW



Direction of travel-----

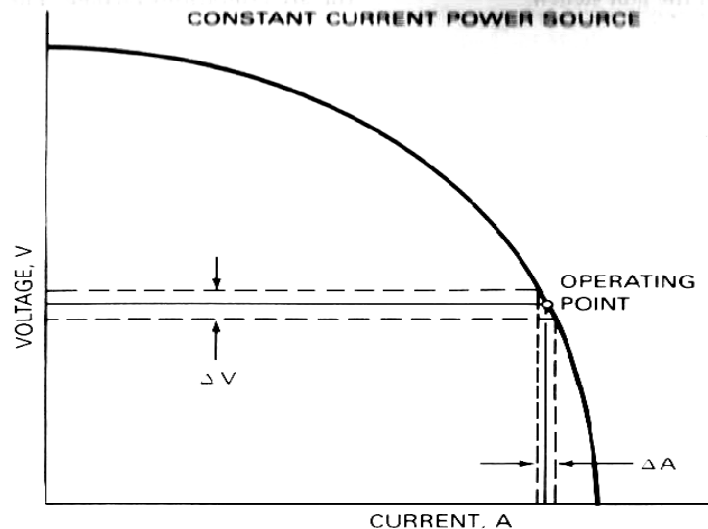
Shielded metal arc welding

(Courtesy : Welding Hand Book AWS, USA, 1966)

- An electric arc is maintained between the end of a coated metal electrode and work piece.
- The flux covering melts during welding and forms gas and slag to shield the arc and molten weld pool
- The flux also provides a method of adding scavengers, deoxidizers and alloying elements to the weld metal

# Drooping characteristics power source

- Designed to give stable operation where the electrode moves up and down with the welders hand eg MMAW and GTAW processes.
- Variation in arc voltage with movement of the welders hand results in very little change in current
- Stable current gives consistent arc heat and weld pool



# *Equipment And Accessories*

## **EQUIPMENT AND ACCESSORIES**

1. Power source
2. Welding and ground cables
3. Electrode holder
4. Ground clamp
5. Chipping hammer and steel wire brush
6. Hand-shield / welding helmet / head-shield
7. Welding electrode
8. Re-drying oven



# MMAW Electrode

- **Core Wire**

- Electrode core wire: C 0.10 max; Mn 0.38-0.62; Si 0.03 max; S 0.03 max; P 0.03 max
- Important feature: low level of C, Si, S & P

- **Coating**

- Arc characteristics – Stability, Striking & Re-striking, Force, Capability to work in positions, and in AC & DC sets
- Slag characteristics – Good shielding, Capability to bring impurities out of molten weld metal, Good detachability, Flowability as well as quick freezing nature



# *Functions of the Flux coating*

- **Stabilises and maintains Arc**
  - To improve metal transfer and reduce spatter
  - They also reduce operating voltage for the electrode.
- **Shielding:** Provided by gases produced by the flux and slag covering during welding
- **Weld Pool Control**
  - Slag fluidity determines the ease of positions welding
  - Fast freezing slag is more suitable for welding in vertical and overhead positions.
- **Alloying Elements:** May contain elements which can improve mechanical properties of the joint



# ***Coating Constituents***

- **Arc stabilisers**
- **Slag formers**
- **Deoxidisers**
- **Gas forming materials**
- **Binders**
- **Alloying elements**
- **Deposition efficiency improvers**
- **Extruding/slipping agents**

# *Coating types*

- **Rutile**
- **Basic**
- **Cellulosic**
- **Acid**
- **Acid-rutile**
- **Oxidizing**

# *Merits/Demerits of coating types*

- **Rutile: Merits**
  - Easy striking/restriking
  - Good slag control
  - Good slag detachability
  - Good positional welding capabilities
  - Usable in low OCV sets
  - More welder friendly
- **Demerits**
  - Limitation in mechanical properties
  - Alloy transfer difficult
  - High hydrogen level



# *Coating Factor*

- **CF = Electrode diameter / Core wire diameter**
- Thin coated:  $CF \leq 1.3$
- Medium coated:  $CF 1.3 - 1.5$
- Heavy coated:  $CF 1.5 - 2.2$
- Super heavy coated:  $CF > 2.2$

# *Merits/Demerits of coating types*

- **Basic: Merits**
  - Good mechanical properties
  - Low hydrogen level
  - Alloy transfer effective
  - Higher deposition efficiency
- **Demerits**
  - Greater welder skill required
  - AC welding difficult, especially in low OCV
  - High temperature preheating before welding necessary
  - Slag detachability not as good as rutile type



# *Merits/Demerits of coating types*

- **Cellulosic: Merits**
  - High arc force  $\Rightarrow$  good penetration
  - Thin coating  $\Rightarrow$  good manouverability in roots
  - Less slag volume
  - Good positional welding
  - Alloy transfer possible
- **Demerits**
  - DC based
  - High hydrogen level
  - Operator skill is important



# ***Classification - AWS A5.1 - 1991***

- **Example : E 6013**
- Letter E indicates covered electrode for MMAW process manufactured by extrusion process.
- Digits 60 indicate minimum weld metal UTS of 60,000 psi
- Digit 1 indicates the position – all positions except V-down
- Digit 13 indicates the type of coating, current condition – High titania, Potassium & AC, DC±



# ***Classification - IS 814 - 1991***

- **Example : EB5426H3JX**
- Letter E indicates covered electrode for MMAW process manufactured by extrusion process.
- Letter B indicates Basic coating.
- Digit 5 indicates UTS 510-610N/mm<sup>2</sup> & Y.S. 360 N/mm<sup>2</sup> (min)
- Digit 4 indicates a min elongation as 20% with impact strength as min 27J at (-30 deg c.



# ***Classification - IS 814 - 1991***

- **Digit 2 indicates that electrode can be used in all positions except vertical down.**
- **Digit 6 indicates that electrode is usable in DC with electrode positive & on AC with min. 70 OCV**
- **Letter H3 indicates that max. H2 level will be 5 ml per 100 gm weld metal.**
- **Letter J indicates that electrode efficiency is in the range 110-129%.**
- **Letter X indicates that electrode deposits radiography quality welds.**



# *Selection Of Covered Electrodes For Applications*

- **MMAW PROCESS IS BEING SUCCESSFULLY USED FOR WELDING OF**
  1. MILD AND CARBON – MANGANESE STEELS
  2. LOW ALLOY STEEL
  3. HIGH ALLOY STEELS AND STAINLESS STEELS.
  4. CAST IRONS
  5. SURFACING APPLICATIONS
  6. COPPER AND COPPER ALLOYS
  7. ALUMINIUM AND ALUMINIUM ALLOYS
  8. NICKEL AND NICKEL ALLOYS



# ***MMAW – Best practice***

## **Selection of welding parameters**

- **Current**

**Current selected is dependent on**

- **Size & type of electrode**
- **Thickness of base material**
- **Welding position**

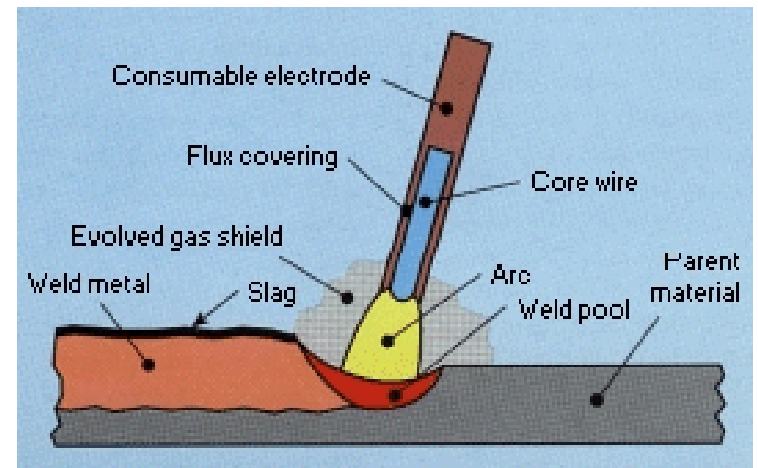
- **Voltage**

**Try to use highest voltage setting available, specially for basic coated low hydrogen electrodes.**

# ***MMAW – Best practice contd.***

## **Operator control**

- **Quality of welding highly dependent on the skill of operator**
- **A high level of manual dexterity is required to co-ordinate the electrode to match the burn off rate and to maintain a constant ARC length.**



# ***MMAW – Best practice contd.***

## **Defects due to lack of operator control**

- **Porosity**
- **Undercut**
- **Insufficient / excess penetration**
- **Lack of fusion**
- **Slag inclusion**
- **Undercut**
- **Incorrect weld size**
- **Incorrect weld profile**