LAB MANUAL

NON - DESTRUCTIVE TESTING LAB

ORISSA SCHOOL OF MINING ENGINEERING
Government of Odisha
ଓଡିଶା ଖଣି ଯନ୍ତ୍ରୀକରଣ ବିଦ୍ୟାଳୟ

METALLURGICAL ENGINEERING DEPARTMENT

ORISSA SCHOOL OF MINING ENGINEERING

KEONJHAR

COURSE CODE: PR - 2

SEMESTER – 6TH

List of Experiments

1. To prepare the Ferrous metal (mild steel) for metallography study
2. To prepare the sample and study the microstructure of Non-ferrous metal (Brass)
3. To study of micro-vicker hardness testing machine
4. Micro hardness of ferrous sample
5. ASTM grain size measurement of ferrous material by using quantimet software
6. To observe photomicrography of different ferrous and nonferrous material

EXPERIMENT-01

AIM OF THE EXPERIMENT

To study the magnetic crack detector and inspection of defect using it.

APPARATUS REQUIRED

1. Specimen
2. Magnetic crack detector
3. Kerosene
4. Red iron powder

THEORY

Magnetic particle inspection method uses magnetic fields and small magnetic particles to detect surface defects or near surface defects in ferrous materials. This method is a relatively simple and easy techniques . It is almost free from any restriction as to size, shape and composition.

When a piece of metal is placed in a magnetic field and the lines of magnetic flux get intersected by a discontinuity such a crack or slag inclusion in a casting,magnetic poles are induced an either side of the discontinuity. The discontinuity causes an abrupt change in the path of magnetic flux-floating through the casting normal to the discontinuity, resulting a local flux leakage field and interference with the magnetic lines of force. This local flux-disturbances can be detected by its affect upon magnetic particles which collect on the region of discontinuity and pile up and bridge over the discontinuity.

A surface crack is indicated by a line of fine particles following the crack outline and a surface defect by a fuzzy collection of the magnetic particles on the surface near the discontinuity.

The flux is induced by the use of a permanent magnet or an electromagnet, by causing current flow through the component or by wrapping coils around it and then passing a current through the coils. In this experiment we used permanent magnet.

PROCEDURE

1. At first the kerosene and red iron powder were mixed to from applicant.

2. Then the sample was taken and cleaned thoroughly.

3. The magnetic crack detector was placed over the specimen vertically.

4. Then it was made it spread through a blower.

5. The applicant was poured acer it throughout the surface.

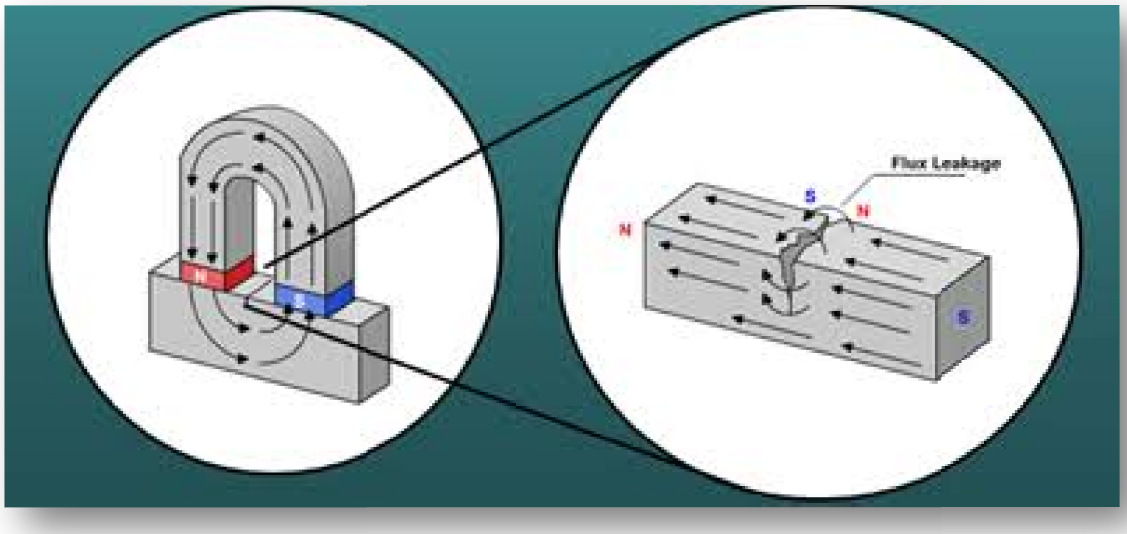
6. Then the result were observed.

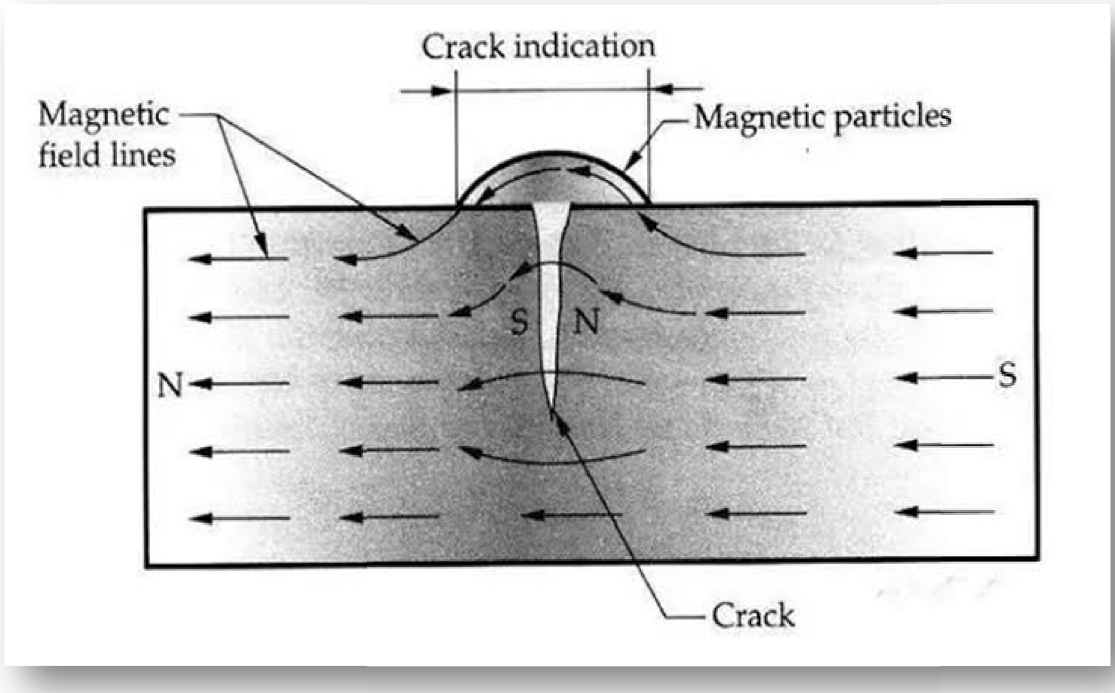
OBSERVATION

It is observed that most of the colored solution magnetic particles containing were concentrated at certain places of the specimen surface.

CONCLUSION

Hence, the colored parts detected the cracks.





EXPERIMENT-02

AIM OF THE EXPERIMENT

To find the surface cracks on the given specimen using dye penetration technique.

APPARATUS REQUIRED

1. Polished weld or cast specimen
2. Liquid dye penetrant
3. Developer

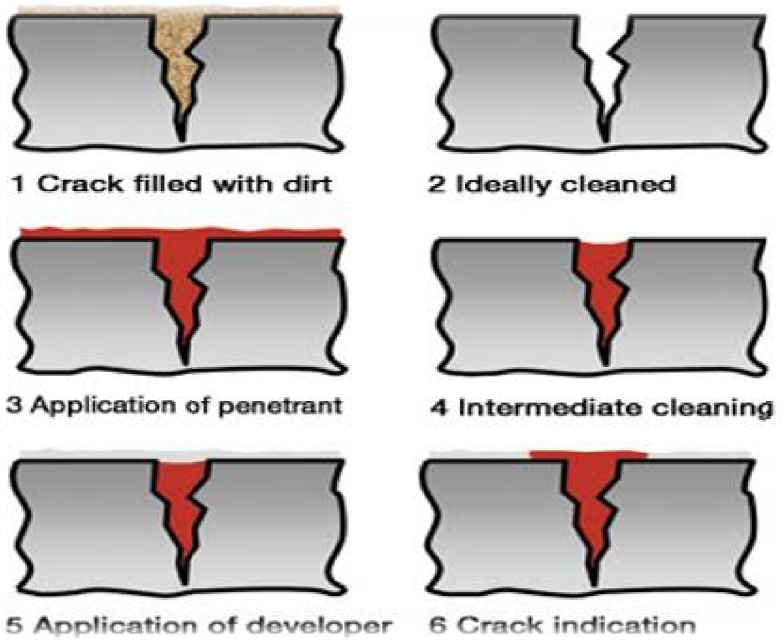
PROCEDURE

Liquid penetrate to penetrate effectively, the surface of the material is thoroughly cleaned of all material that would obstruct the entrance of the liquid into the defect.

1. The liquid penetrant is applied evenly over the surface and solvent is applied to clean the surface.
2. It is then completely removed from the surface and solvent is applied to clean the surface.
3. Then wet developer is applied.
4. In liquid that has penetrated the defect will bleed out on the surface, and the developer will help delineate them.
5. This will be show the location, general nature and magnitude of any defect present.

CONCLUSION

The surface flows are detected on steel, mild steel and all specimen.



EXPERIMENT-03

AIM OF THE EXPERIMENT

To study the ultrasonic flaw detector & inspection of defects by using ultrasonic flaw detector.

APPARATUS REQUIRED

I. Ultrasonic flaw detector
II. Standard test specimen
III. Transducer or probe
IV. Lubricant oil

THEORY

I. Ultrasonic flaw detector is a device, which is used to detect internal discontinues in the material by non-destructive means.
II. It makes use of phenomenon of back reflection (echo0 by surfaces.
III. Sound waves oscillation with a frequency greater than 2000cps is inaudible & is known as ultrasound.
IV. High frequency sound is produced by a piezoelectric crystal, which is electrically pulse & then, vibrate at its own natural frequency.
V. In order to transmit the sound waves from the crystal to the metal, it is necessary to provide an liquid coolant. This is accomplished by using a film oil between crystal & the test piece to remove all gap between the surface of the specimen & probe.
VI. After the crystal has given off its short burst of sound waves, it stops vibrating & listens for returning echoes i.e. one crystal probe is used to send & received the sand.
VII. This cycle of transmitting & then receiving is repeated at an adjustable rate from 100 to 1000 times per seconds.
VIII. Returning echoes on CRT causses short vertical spikes called pips. These are spaced along the baseline according to their time of receipt.
IX. Since the sound travels at the material at a constant speed, the spacing of pips can be considered as indicating thickness. Selection & expanding full screen size of the CRT can eliminate unwanted echoes caused by reverberations with the test piece.

PROCEDURE

I. The surface of the specimen was cleaned properly.
II. The probe was placed against the test specimen by using a thin oil film or lubricant.
III. The power was supplied to the ultrasonic flaw detector & the machine was calibrated for measurement.
IV. The calibration was achieved by setting the signal at a pre-determined amplitude level.
V. Then we placed the probe on the specimen & the signals were observed.

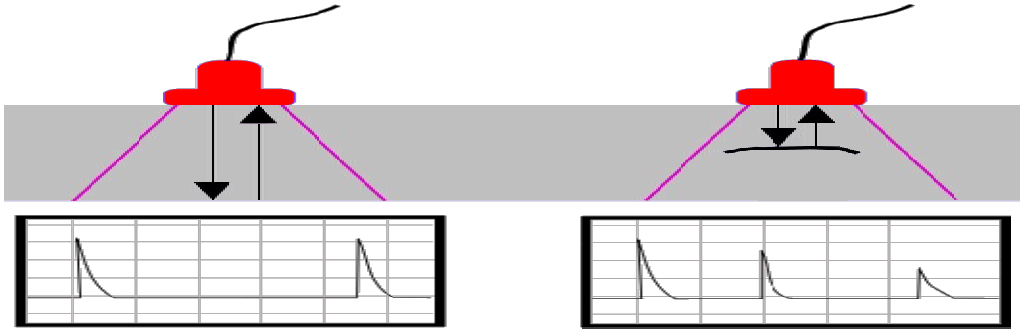
OBSERVATION

We observed four signals

- The first one line is the transmitting signal.
- The last line is receiving.
- The middle two short lines are cracks.
- The middle two lines are detected the cracks at below from the surface.

CONCLUSION

- Hence the ultrasonic flaw detection test was done by ultrasonic flaw detector.
- There were two cracks were detected from this experiment.
- The two cracks were detected at below the surface of the specimen.



ULTRASONIC FLAW DETECTOR

EXPERIMENT – 04

AIM OF THE EXPERIMENT

To measure the temperature by using thermocouple.

APPARATUS REQUIRED

I. Chromel- Alumel thermocouple
II. Thermometer (Mercury thermometer is used to read the actual temperature of the water).
III. Vessel (Glass vessel or cup is used to melt the ice with water).
IV. Voltmeter with precision at least of 10^{-3} (Electrial device used for measuring the induced emf).
V. Chart recorder – (Mechanical second order system, used for plotting the response of other systems directly on paper, it transforms the input voltage to a move the plotter head on plotting surface).
VI. Ice & hot water.

THEORY

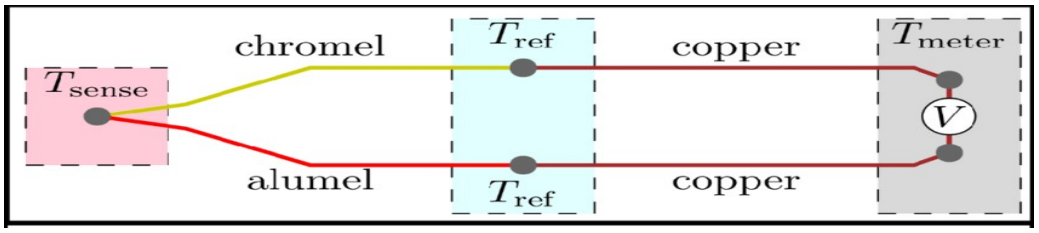
- Since many of the matter features are related to the temperature, such as the pressure, electrical resistance, expansion co-efficient, etc, & they change with it, they can be used to measure the change in the temperature of bodies.
- The electrical resistance is mainly used widely because of the high accuracy & ease to use. The temperature change tends to change the resistance of the material being used for this purpose, so the material draw a voltage signal, can be amplified & measured as an indication to the temperature change.
- When the thermocouple junction receives a temperature change an emf is existed between the two points "A" & "B" this phenomenon is called the see-beck effect.
- Thermocouple connection depends on two terminals, so if the temperature of one terminal is known its easy to find the other terminal temperature using the thermometer properties of the materials, which are listed in standard tables. The known temperature of the first terminal called the reference temperature & its commonly used to be "0^0C", established in an ice bath.
- Standard tables are prepared on this basis, which relates the generated emf with the temperature & are based on a third order polynomial regression-

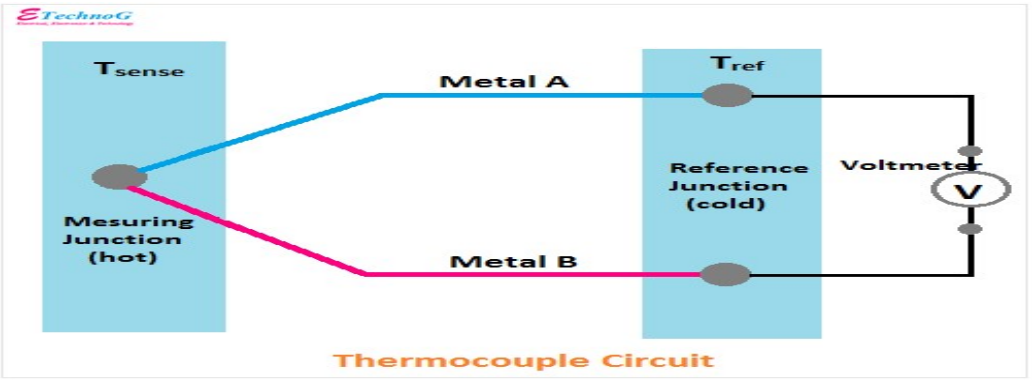
$$E = AT + (BT^2/2) + (CT^2/3)$$

Where the constants A, B & C depend on the material type of the thermocouple used.

- The thermocouple is mainly used in several applications, such as measuring body's temperature when it's difficult to be measured using the traditional thermometer, also thermocouples can be used as a control system, when the temperature is the affecting parameter.
- For example : the fire safety systems the furnaces shutdown system and many other applications to attain higher accuracy multi thermocouples are connected in series the configuration is called thermocouple when connecting multi thermocouples in parallel with

each thermocouple end at a different temperature (but having the same reference) the average value of their temperatures are given.





PROCEDURE

1. The thermocouple was prepared by joining the ends of both wires, (either by mechanical means or by welding them electrically, & electrical welding is used in this experiment)
2. The free end of the thermocouple was connected in the voltmeter & set a scale of 10^{-3}i.e m-volt.
3. The ice was put in the vessel & the welded end was contacted & the voltage was read.
4. Thermometer was used to measured the temperature and it was converted into an emf using the standard tables of chromel thermocouple. ($V_{thermocouple}$)
5. Then the voltage from the voltmeter was read & than it was a (induced voltage) temp was converted into temperature using the standard table. (called $T_{voltmeter}$)
6. Some water was added to the vessel & readings were recorded.
7. This process was repeated 6-8 times.

TABULATION

	Temperature					
SL No	**Tc (0^0C)**	**V_c**	**T_r (0_0C) measured**	**T_w (0^0C) calculator**	**ΔV**	**$V=V_0$ ΔV**
1						
2						
3						
4						
5						
6						
7						
8						

9						
10						

CALCULATION

The See-beck co-efficient for the chromel –alumel thermocouple is

K= 41μV/Kelvin

Assuming linear relation-

$T_r = T_c$ TΔV/K

CONCLUSION

- Thermocouples are widely used devices due to its simplicity & linearity for a wide range of temperature differences.
- The arrangement of many thermocouples determines whether the device is used for more sensitive measurements or multi temperature.