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Improvement Test – Nov. 2017

Sub:	Metal Casting & Welding					Sub Code:	15ME35A	Branch:	MECH
Date:	20/11/2017	Duration:	90 min's	Max Marks:	50	Sem / Sec:	3SEM / A & B		OBE

Answer any FIVE FULL Questions

		MARKS	CO	RBT
1	Define solidification and briefly explain the solidification variables	10	CO5	L1
2	Briefly explain the homogeneous nucleation & heterogeneous nucleation	10	CO5	L1
3	Define degasification and briefly explain the methods of degasification	10	CO5	L1
4	Briefly explain the any five casting defects with reasons & remedies	10	CO4	L1
5	Explain drossing and gas absorption during aluminium casting	10	CO5	L1
6	Explain with neat sketch of magnetic particle inspection method with advantages and disadvantages	10	CO8	L1
7	Explain with neat sketch of X-ray radiography inspection method with advantages and disadvantages	10	CO8	L1

Metal casting and Welding

Improvement test Solution

Subject code: 15ME35A Date: 22/11/17

① Define Solidification and briefly Explain the Solidification Variables.

Solidification is the process where liquid metal transforms into solid upon cooling.

Transformation from liquid to solid metal is Accomplished by a shrinkage in the volume.

Solidification Variables

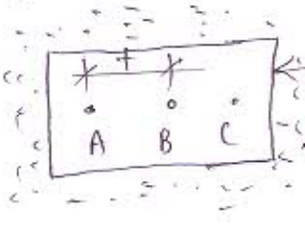
(i) Solidification time (S_T) :- It is a time taken by the metal or alloy to transform from liquid to solid state.

⇒ Lesser the solidification time, better will be the properties with Reduce Shrinkage

⇒ Solidification Time will be Express in seconds

⇒ Sand mould posses longer solidification time metallic mould posses shorter solidification time.

(ii) Solidification Rate: It is defined as Rate at which the solidification in progress from 1 point to another point.



Where A & B are the two Adjacent points & thickness of Metal Solidified.

⇒ If solidification between two Adjacent points 't'

$$X = K\sqrt{t} \quad \text{---} \quad (i) \qquad K = C$$

differentiat eqn (i) WRT

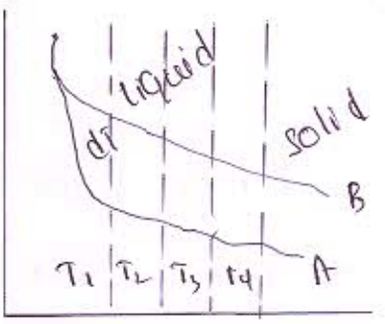
$$dx/dt = K/2\sqrt{t} \quad \text{---} \quad \text{(ii)}$$

If the Smaller solidification time, longer the solidification Rate & vice verse

Higher solidification Rate better is the property of casting

$\Rightarrow$ Expressed in cm/sec.

(iii) Temperature Gradient (G) :



Consider metal solidification betcoeen A & B. cooling Curve correspond to the tcoo points

Where dx $\Rightarrow$ distance b/co tcoo Adjacent

dt $\Rightarrow$ Difference in temperature b/co tcoo points

Temp Gradient at T_1

$$G_1 = \frac{dT_1}{dx} \qquad G_2 = \frac{dT_2}{dx}$$

$\Rightarrow$ Higher the value of G is better will be the casting Temp Gradient will be Expressed in $^oC/cm$.

(iv) cooling Rate : The Rate at which liquid metal is converted into solid

$\Rightarrow$ Smaller the solidification time longer the cooling Rate & vice verse

$\Rightarrow$ It is Expressed (dx/dt) with unit cm/sec

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② Briefly Explain the Homogeneous Nucleation and Heterogeneous Nucleation.

Homogeneous Nucleation

When Nucleation takes place in liquid metal without the help of any impurities. then It is known as Homogeneous Nucleation

It occured in 2-3 atoms cluster forms a Nuclei.

Latent heat (Δfv) is Released during Solidification in given by

$$\Delta fv = -4/3 \pi r^3 \Delta G \quad \text{---(i)}$$

Where $r \Rightarrow$ radius of Nuclus formed

$\Delta G \Rightarrow$ Latent heat Energy Released

In the melt, Surface Energy associated newly formed nucleus is given by the Relation

$$\Delta fs = 4\pi r^2 \gamma \quad \text{---(ii)}$$

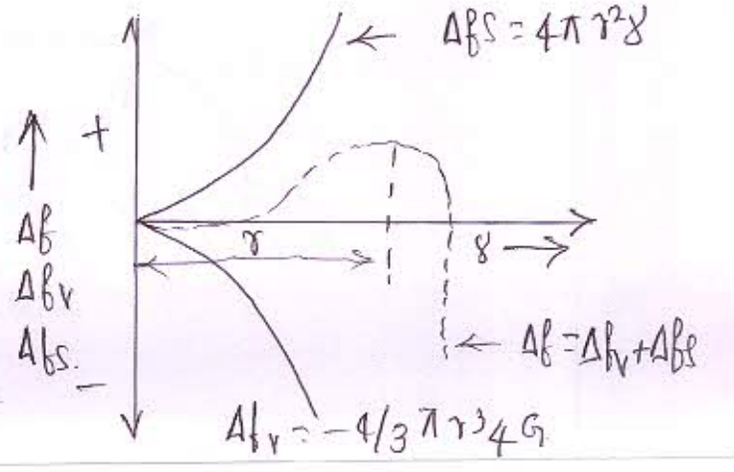
Where $\gamma \Rightarrow$ Surface Energy / unit area

Thus Net Energy Changes for particle of Radius r is given by

$$\Delta f = \Delta fv + \Delta fs$$

$$\Delta f = -4/3 \pi r^3 \Delta G + 4\pi r^2 \gamma \quad \text{---(iii)}$$

fig Shows the Relationship between latent heat and Super Energy with increase in Radius of Nuclie. As the particle size increases till the



Increases till the nucleus Reaches a critical Radius r' but with further increase in particle Radius the free energy decreases and even becomes negative.

The size of the critical Radius can be Estimated by fid differentiating eqn ③ with Respect to r' and equating to zero

$$d/dr(\Delta f) = d/dr\left(-4/3\pi r^3 \Delta G + 4\pi r^2 \gamma\right) = 0$$

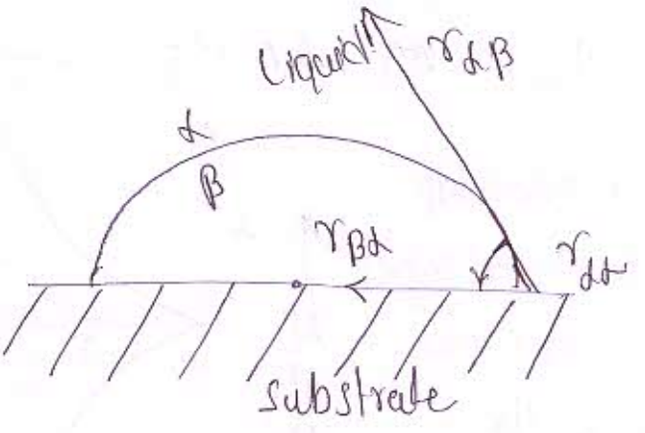
Heterogeneous Nucleation

When nucleation takes place in liquid metal with the help of impurities then it is known as Heterogeneous nucleation.

Nuclei is heterogeneous occurs on the surface of the above possible surfaces often called the substrate.

(ii) The substrate surface must be Actually melted by the liquid metal

(iii) The contact angle (θ) of the cap-shaped nucleus should be less than 90° theoretically



③ Define degasification and briefly Explain the methods of degasification.

Degasification is the process of Removal of gas from molten metals or alloys

Methods of degasification

⇒ use of flux: Fluxes are Employed to Remove the gases from the molten metal. Degalification by using flux is suitable only for Non ferrous metals

The commonly used flux Material is the mixture of NaCl + KCl. This mixture is Employed with aluminium alloy. flux lowers the surface tension of oxide films and get in b/w Al_2O_3 and aluminium interface.

⇒ Flux washing process: In this process gases from the molten metal is Removed by dissolution of fluxes. Here molten metal is Subjected to the agitation with flux. and Ensure proper dissolution of flux within molten metal. The dissolved flux material Removes the gases from Metal

⇒ Degasing using Inert gases:

Dissolved gases from the molten metal can be Removed by using inert gases. Inert gases introduced into the molten metal under pressure. Results formation of large numbers of

Small bubbles within the molten metal, these bubbles Creates low pressure Region into which the dissolved gases gets diffused. Bubbles along with dissolved gases floats to the top core also Removed during the process.

⇒ Vaccum degasing : The gases from the molten metal can also be Removed by vaccum degassing method.

The amount of gas dissolved in the molten metal is a function of partial pressure of the surrounding atmosphere

i.e $S \propto \sqrt{P}$

Gases from the molten metal can be Removed by Reducing surrounded atmospheric pressure.

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(4) Briefly Explain the any five casting defects with Resons and Remedies

(i) Mis Run

When the Metal is unable to fill the mould cavity completly and thus leaving unfilled portion called Miss Run. which occcurs due to

Caused Remedies

* Insufficient fluidity of the Molten Metal
* Absorption of gases by the liquid Metal
* Improper alloyment of Mould
* Increase Metal pouring temp.

Metal penetration

Causes

* Use of large grain size
* Soft Ramming of Mould
* Moulding Sand or core has low strength and has High permeability
* pouring temp of the Metal too High

Remedies

* Use sand having finer grain size
* provide Hard Ramming
* Maintain proper pouring temp.

Cold Shut

A cold shut is caused when two streams while meeting in the mould cavity, donot fuse together properly thus forming discontinuity.

Causes

* Very poor pouring practice
* Improper gating system
* low metal fluidity
* lower permeability.

Remedies

* Increase Metal or mould temp
* Improper gating to an hence mould fill.

Mould Shift

The Mould shift defect occurs when Cope and drag boxes have not been properly aligned.

Remedies

* Change coormact pins. bushes
* Mount the pattern correctly.

porosity

Causes

* High coring temp
* Less flux used
* gas deserved in Metal charge
* Molten Metal Not properly de-gased
* Slow solidification of casting
* High moisture and low permeability in mould.

Remedies

* Maintain proper pouring temp
* Increase flux proportions
* Ensure effective de-gassing
* modifly gating & Raising System to attend proper solidification
* Reduce moisture & increase permeability of mould.

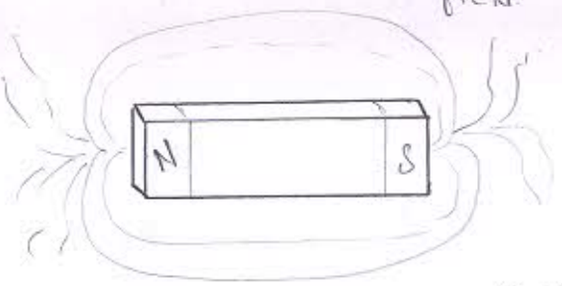
(5) Explain drossing and gas absorption during Aluminium casting.

Drossing: Melting occurs most rapidly if a heel of molten aluminium is present when the charge is added. Melting down with minimum dross formation occurs when the charge is protected from combustion products and melting is rapid. Drossing is the formation of Aluminium oxide & other oxides which accumulate on the melt surface. Complete Separation of dross and Metal would be favored by large differences in their specific gravities.

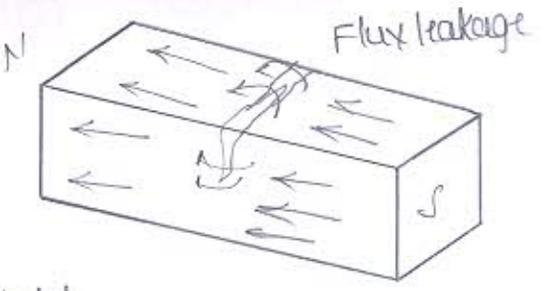
Gas Absorption: If given the opportunity, aluminium alloys will absorbs or dissolve harmful quantities of Hydrogen gas. Temperature exerts a profound Effect on the maximum solubility of Hydrogen in aluminum, as illustrated. At the melting point an Abrupt increase in solubility occurs. If the Solubility limit is Reached at pouring temperatures, Subsequent cooling and solidification will Result in gas Evolution.

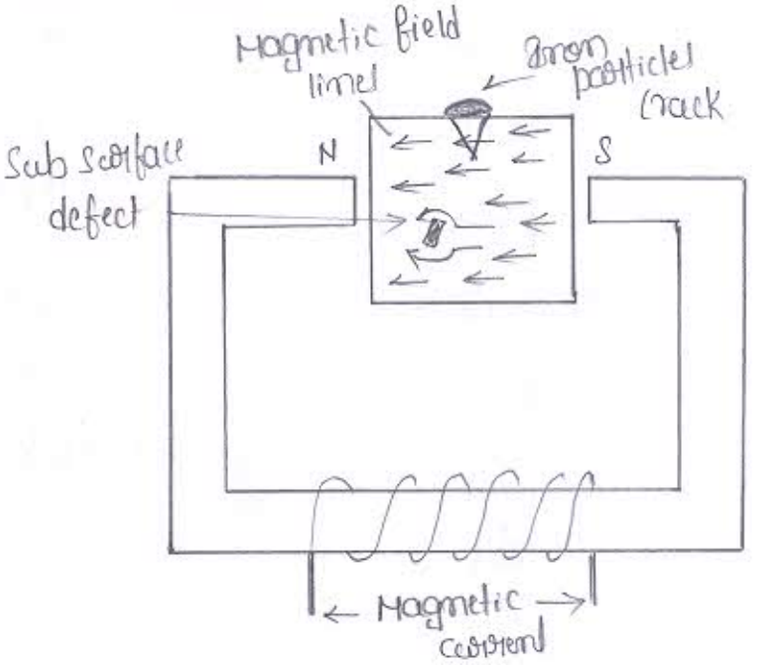
(6) Explain the neat sketch of magnetic particle inspection method with Advantages and disadvantages.

Magnet with magnetic lines field



Magnet with flux leakage





Steps involved in the inspection Method

(i) The first step in a magnetic particle testing is to magnetize the component that is to be inspected as shown in fig

(ii) If any defects on or near the surface are present the defects will create a leakage field. ~~form are Applied to the~~

(iii) After the component has been magnetized, iron particles, either in a dry or wet suspended form, are Applied to the surface of the magnetized part.

(iv) The particles will be attracted & cluster at the flux leakage fields. thus forming a visible indication that the inspector can detect.

Advantages

(i) High sensitivity
(ii) Minimal surface preparation
(iii) portable
(iv) Low cost

Dis Advantages

(i) Only surface and near surface defects can be detected
(ii) Only Applicable to ferromagnetic materials
(iii) Relatively small area can be inspected at a time
(iv) only material with a Relatively nonporous surface can be inspected.
(v) The inspector must have direct access to the surfaces being inspected.

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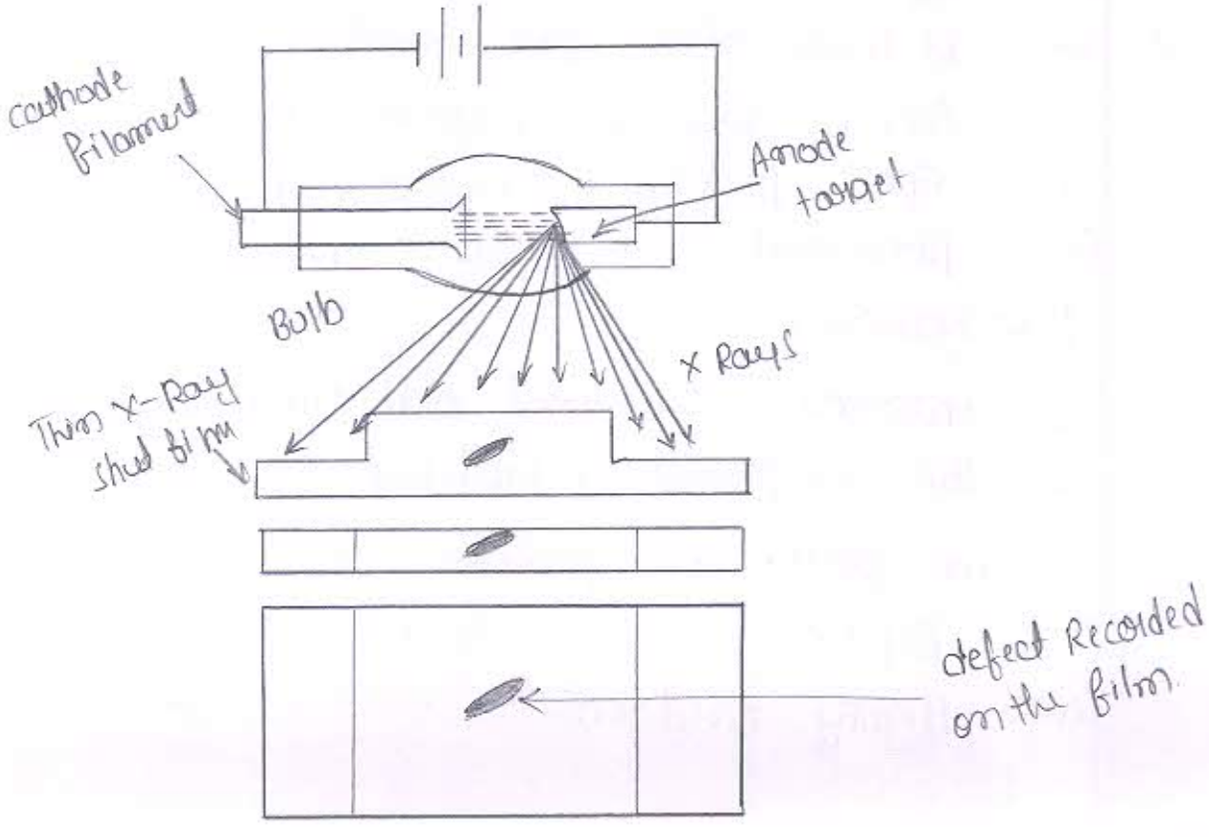
(7) Explain with neat sketch of X-Ray Radiography inspection method with Advantages and disadvantages.



(i) The equipment consist of a filament acts as cathode and target acts as anode. which in turn are placed in Evacuated glass bulb.

(ii) The filament is heated by passing an Electric current through cathode and anode

(iii) When Electrons collide with target a part of kinetic Energy is converted into Energy of Radiation

(iv) When X-Rays are passes through the material containing a defect. the sound part of the workpiece possesses thicker and denser area will stop more Radiations.

(v) The Radiation that passes through the workpiece will Expose the film and form a shadowgraph of the part. the image darkness will vary with the amount of Radiation Reached the film through the test object where darker areas indicate more exposure and liter areas indicate less exposure.

Advantages

(i) Both Surface and internal discontinuities can be detected

(ii) Significant variations in composition can be detected

(iii) It has a very few material limitations

(iv) Can be used for inspecting hidden areas

(v) Good portability Especially for gamma-Ray Sources

(vi) permanent test Record is obtained.

Disadvantages

(i) Hazardous to operates and other nearby personnel

(ii) The equipment is Relatively Expensive

(iii) The process is generally slow.

(iv) Depth of discontinuity is not indicated

(v) Highly directional.