**A study on Transportation properties influence on micro structure of concrete-review**

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**Abstract:**

The micro structure of concrete is influenced by macro structure of concrete. It exhibits different phenomenon in different phases. A porous structure is formed where water reacts with cement, aggregate and hardened. Water acts as medium to carry out the particles or ions inside to outside or (and) vice versa. Soon after setting of concrete, this structure is studied through different methods like mercury intrusion porosimeter, gas adsorption method, back scattered electroscopy method, XRD method etc. Yet, without mathematical approach, finding the properties of transportation, viscocity and important characteristics of concrete is impossible with analytical and experimental methods. Diffusivity, sporptivity, conductivity, permeability through mathematical methods are discussed here. Pores are classified as entrained air, entrapped air, capillary pores, gel pores based on their origin, size, shape and behavior when interacted with neighboring particles. Transport properties effect durability than of concrete where it has been noticed that corrosion, micro cracks, efflorescence, and deterioration cause effects in long run.

**Introduction:**

A good concrete must be homogenous and impermeable. Good water cement ratio gives a workable concrete. But when the hydration is not done properly or due to inadequate curing, problem arises as the desired properties of concrete is not attained. Soon after setting of concrete, it gains a porous hard state which is called concrete. The water in the porous block acts as a carrier of electrons or particles from inside to outside or (and) vice versa. Concrete consists of 10-15 % of cement, 60-75% of aggregates and 15-20 % of water.

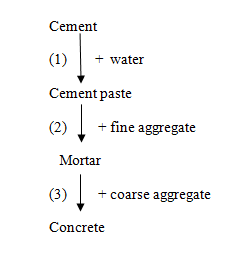


Fig 1.

**Formation of pores in concrete:**

(1). In this stage, cement mixed with water gives a paste which is highly viscous. To reduce its viscocity, improve aeration inorder to avoid early cracks, fine aggregates are used.

(2). When the mortor is mixed with coarse aggregate, the cement binds the aggregates and forms C-S-H gel pores which contributes to the transportation of particles.

(3). The surface area, shape, cleanliness and nature of the coarse aggregate leads to chemical and physical reactions in mortor-aggregate interphase. The size of pores vary from several nanometers to millimeters here.

Deterioration of concrete occurs due to problem due to corrosion of steel concete interphase, sulphate attack, temperature changes like froast acting which leads to internal cracking(1). Homogenization analysis and molecular dynamics simulation are few of methods used to analyse the pore strucure of concrete where inhomogenious micro structure is evaluated first followed by macro structure(2). Diffusivity, permeability, Sorptivity are the main transport properties should be given much attention in the view of durability of concrete(3). Water influences ionic diffusivity and gas permeability where there exists a critical saturation level restricting connected pore path for transport of ions or gas(4). This paper gives a mathematical approach to find out different transport properties of concrete based on several researches.

**Transportation properties on cement:**

**By diffusion:**

Diffusion of is a physical phenomenon when water molecules transfer from high concentation to low concentartion. Due to improper washing of aggregates or excessive addition of CaCo3 for increasing setting time, Cl shows a severe effect on concrete through diffusion. So controlling Cl has become inevitable. Many studies were done on its diffusion into concrete through Fick’s first law for one dimentional steady flow(5)

J = Deff

J = flux of chloride ions,

Deff = effective diffusion coefficient

C = concentration of chloride ions

x = position variable

When it changes with time, the non steady flow is derived by Fick’s second law of diffusion.

= Deff

Where the boundary conditions are

1. Surface concentration id constant C(x=0,t>0) = C0
2. Initial condition C(x>0,t=0) = 0
3. Infinite point condition C(x=∞, t>0)=0

**By permeability**: The rate of flow of water into a porous medium is called permeability. Along with water, unwanted particles too gets into the medium leading to unwanted reactions in the concrete.

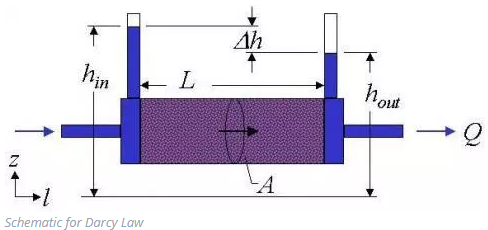


Fig 1

The rate of steady flow is learnt from (6), using Darcy’s equation, for a saturated specimen under a hydrostatic pressure gradient is

Q

Q = = rate of fluid flow(m3/s), K= intrinsic permeability(m2) = hydrostatic pressure gradient(m),A= area of cross section of sample(m2), L= thickness of solid( m), v= dynamic viscosity of fluid (s/m2) , = density of fluid(kg/m3) g= acceleration due to gravity(9.81m2/s)

**By conductivity**: This transport phenomenon is different from diffusion and permeability as its transportation phenomenon witll be in terms of electrons and electrolysis. Earlier two processes works on the effect of gravity and spontanious. Conductivity occurs under the influence of external factors like chemical reactivity, temperature, surface exposed to high frequency radiation etc. Conductivity of a concrete (7,8) can be derived from Einstein relation:

Where = electrical conductivity, e= , k=absolute temperature, T=time, number of ions in unit volume,=valency,=diffusion coeffecient of ions of type j

**By sorptivity:** Sorpitivity is the surphase phenomenon of a material where absorption and seaoption occurs. This is influenced by capillary action of pores in a mix. The effect of sorptivity is derived with respect to water abostption and results are evaluated from the formula(9)

S =

S= sorptivity in mm, t= elapsed time in minutes the amount of water absorbed is known by placing the sample in oven for particular time(t) and temperature where w is the difference in weight of the specimen after 30mins of drying

I= w/Ad

A= surface area of specimen and d= density of water

**Conclusion:**

From these methods one can come to know the affect of porosity on structural concrete. Void diameter and void volume plays an important role in accessing the properties. Effect of micro cracking, leaching, thrawing acting etc can also be studied through pore structure. So, evaluation of pore structure and control of porosity, permeability in turn transport properties can be done by following these techniques.

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