Absorption of impinging water droplet in porous stones

J.B. Lee et al.w  
  
In 2016 Lee et al. have investigated the behavior of the This paper presents an experimental investigation and numerical analysis of the absorption of water droplets impacting porous stones. The absorption process of an impinging droplet is here fully characterized from spreading to evaporation in terms of absorbed mass during droplet depletion and moisture content distribution in a time-resolved manner for three different natural stones. High-speed imaging and neutron radiography are used to quantify moisture absorption in porous stones of varying moisture properties from deposition until depletion. During impact and spreading, the droplet exhibits a dynamic nonwetting behavior. At maximum spreading, the droplet undergoes pinning, resulting into the contact radius remaining constant until droplet depletion. Absorption undergoes two phases: initially, absorption is hindered due a contact resistance attributed to entrapped air; afterwards, a more perfect capillary contact occurs and absorption goes on until depletion, concurrently with evaporation and further redistribution. A finite-element numerical model for isothermal unsaturated moisture transport in porous media captures the phases of mass absorption in good agreement with the experimental data. Droplet spreading and absorption are highly determined by the impact velocity of the droplet, while moisture content redistribution after depletion is much less dependent on impact conditions.

This paper presents an experimental investigation and numerical analysis of the absorption of liquid droplets impacting porous

stones. High-speed imaging and neutron radiography are used to quantify moisture absorption in three natural stones of varying

porosity and moisture uptake characteristics. Neutron radiography provides quantitative distribution of high resolution moisture content throughout the different phases of the phenomenon. The life of a droplet after impact on a porous stone continues over different time scales. At short time after drop impact the droplet spreads showing a non-wetting dynamic behavior. During this dynamic phase, no liquid mass penetrates into the porous substrate due to the presence of an air layer between the droplet and the porous substrate. At maximum spreading, the air layer between droplet and surface is broken at the contact line leading to capillary contact and pinning of the droplet due to capillary forces in the pores at the droplet edge. As a result, the contact angle changes from a nonwetting to wetting behavior, while air remains entrapped under the pinned droplet. During the absorption phase at larger time

scale, the droplet remains pinned and the contact angle decreases in a constant contact radius (CCR) mode. The mass absorbed in the stone increases until the droplet is depleted. The absorption phase is first hindered by the presence of entrapped air, leading to a contact resistance for fluid transport from droplet to substrate. The entrapped air shortly disappears from the contact zone leading to perfect capillary contact between droplet and porous medium. Droplet absorption and depletion happens faster in highly capillary active stones. Evaporation and further redistribution are observed once the droplet is depleted. Droplet spreading, as well as droplet depletion and evaporation, is highly determined by the impact velocity of the droplet. A finite-element numerical model for isothermal moisture transport in unsaturated porous media is found to capture properly the mass absorption as observed in the

experimental data. A good agreement is obtained between the average moisture content over sample depth from neutron radiography measurements and the numerical results, for absorption and evaporation phases.

Effect of Coloring With Various Metal Oxides on the

Microstructure, Color, and Flexural Strength of 3Y-TZP

K. Shah et al.

Coloring 3Y-TZP with cerium acetate solutions up to 5 wt %

yielded a favorable shade while not affecting the mechanical

properties significantly. Higher concentrations led to a significant

decrease in flexural strength with no further significant

change in DE\* values. Coloring with cerium chloride was

most efficient, leading to higher DE\* values than cerium acetate

or bismuth chloride. However, it also led to a significant

decrease in flexural strength even for concentrations as low as

1%. Coloring with bismuth chloride is possible at low concentrations

of 1% or less without adverse effects on flexural

strength. The resistance to low temperature degradation was

not affected by any of the coloring solutions tested.

**State of the art of zirconia for dental applications**

***Isabelle Denrya*,∗*, J. Robert Kellyb***

At ambient pressure, unalloyed zirconia can assume three

crystallographic forms depending on the temperature. At

room temperature and upon heating up to 1170 ◦C, the

symmetry is monoclinic (*P*21/*c*). The structure is tetragonal

(*P*42/*nmc*) between 1170 and 2370 ◦C and cubic (Fm¯3m) above

2370 ◦C and up to the melting point [2,3]. The transformation

from the tetragonal (*t*) phase to the monoclinic (*m*) phase upon

cooling is accompanied by a substantial increase in volume

(∼4.5%), sufficient to lead to catastrophic failure. This transformation

is reversible and begins at ∼950 ◦C on cooling. Alloying

pure zirconia with stabilizing oxides such as CaO,MgO,Y2O3 or

CeO2 allows the retention of the tetragonal structure at room

temperature and therefore the control of the stress-induced *t*→*m* transformation, efficiently arresting crack propagation

and leading to high toughness

**Optical behavior of dental zirconia and dentinanalyzed by Kubelka–Munk theory**

***Oscar E. Pecho et al***

Zirconia systems with higher transmit-tance should be used to restore dental structures with no masking needs

Infiltration time and imprint shape of a sessile droplet imbibing porous medium

B. Markicevic et al



