Absorption of impinging water droplet in porous stones

J.B. Lee et al.w  
  
In 2016 Lee et al. have investigated the absorption behavior of water drops impinging porous stones experimentally and numerically. The investigation includes the phases from spreading to evaporation for a water droplet considering the absorbed amount of the droplet during the depletion and spreading of the humidity within the manner depending on time for three porous materials. Quantitative measurements of the water absorption for the materials are conducted with high-speed imaging and neutron radiography methods during the time range from the impact moment to the end of the spreading phase after absorption. Neutron radiography shows a high resolution quantitative distribution of absorbed water. During the first contact and deposition on the surface the droplets do not exhibit a wetting behavior. As soon as the droplet acquires its maximum diameter on the surface, it gets fixed and the contact angle with the surface remains constant as long as the droplet is not drained by the stone. The absorption behavior doesn’t have the same attributes throughout the whole process. At the beginning the material shows a contact resistance blocking the absorption, which is associated with the entrapped air beneath the area encapsulated by the borders of the water droplet. In the second phase the encapsulated air finds a way to diffuse away so the capillary flow takes place flawlessly until the total disappearance of the droplet on the surface is observed. The experimental data shows accordance to the phases of the numerical model for water flow inside the unsaturated porous material. The collision velocity has a huge effect on drop spreading on the surface and impregnation, but not so much on the distribution of the water after the initial absorption. The absorption and distribution rates are highly relevant to the capillary structure of the stones.

Effect of Coloring With Various Metal Oxides on the

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

K. Shah et al.

On a different aspect some research has been conducted about the effect of the colouring process on the structural strength of the zirconia. In the research of Shah et al. colouring zirconia with cerium acetate mixtures with a maximum ink weight ratio of 5% provided a distinctive shade and did not cause a mechanical disadvantege. However, the ratios above 5% have decreased the mechanical properties while not increasing the shading level significantly. The paper also includes data for case where the coloring process is conduted using cerium chloride and bismuth chloride. For both cases 1% coloring agent was the limit, if the flexural strength was to be conserved. The low temperature degredation was also observed in the frame of the paper, which did not show any co-dependence with the coloring solution.

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

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

The crystallographic state of zirconia depends on the temperature under atmospheric pressure. Until reaching a temperature of 1170 degrees Celcius the crystallographic structure shows a monoclinic symmetry. After that temperature the structure can be defined as tetragonal until 2370 ◦C, which afterwards becomes cubic up to the melting point. The volume of the material increases about 4.5% during the transformation from tetragonal to monoclinic phases, which is enough to cause a crack induced failure. This evitable transformation begins at about 950 ◦C while cooling down and the only way to stabilize the tetragonal structure is creating Cao, MgO, Y2O3 or

CeO2 oxides inside the structure to keep the tetragonal formation at room temperature, which eliminates the crack induction and therefore the structural failure of the material parallel to an enhanced toughness.

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

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

Pecho et al. have conducted experiments to analyse the optical behaviour of dental zirconia and dentin in comparison utilizing Kubelka-Munk theory. The results show that the current zirconia materials alone could not satisfy the luminous transmittance of the natural dentin so an additive application of masking is required to reach an approximate transmittance to the natural tooth.

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

B. Markicevic et al

The infiltration time of the porous medium was formulated by Markicevic et al. in ….. as:  
  
formula  
  
t in defines the infiltration time and depends on the parameters Kapa, which is the permeability constant of the medium and miyuw the kinematic viscosity of the fluid. The initial drop radius is symbolized by r0. Theta stands for the initial contact angle after the impact of the droplet on the surface. The Sigma in the denominator is the surface tension of the liquid. The higher the surface tension is the harder it is for the liquid to wet the surface of the material because of the increased contact angle and hardened impregnation capability. The last dependency of the infiltration time is the Phi constant for the material, identifying the porosity level of the material.



**Spreading of Liquid Drops over Thick Porous Layers**

**Complete Wetting Case**

V. M. Starov et al.

Stratov et al. have provided experimental results regarding the spreading phases of silicon oil droplets utilizing capillary forces over different permeable layers and observing the diameters of the droplets and wetted areas over time. They have divided the depletion into two phases, of which the first one is defined by the time to reach the maximum diameter for the drop base and the second one is identified by the reduction of the drop base while the depletion takes place. The findings of the experiments show that the different oils on the different porous material with similar porosity and mean pore dimensions. showed similar spreading characteristics on a different time scale and the contact angle remained constant throughout the second stage.

Spreading of Liquid Drops over Saturated Porous Layers

V. M. Starov et al.

The dispersion behavior of liquid drops inside porous media which are previously saturated with the identical liquid are examined in the work of Starov et al. The study was conducted considering both theoretical and experimental perspectives. The study was conducted both theoretical and experimental perspectives. The spreading of a liquid on a dry solid medium is governed by a power law and it is shown that the same power law applies to the case with saturated medium. The liquid flow within the porous medium is modeled using the Brinkman’s equations. The effective lubrication and the liquid exchange between the drop and the porous medium are found to have equal significance through which the drop dispersion equation is generated.

**Spreading and Imbibition of Liquid Droplets on Porous**

**Surfaces**

1. Clarke, et al

The impact and spreading of liquid drops on impermeable

solid surfaces is an everyday experience, e.g.,

raindrops on a windowpane. The topic has been the subject

of many experimental and theoretical studies, and much

progress has been made recently in explaining the

underlying phenomena.1-4 By contrast, the spreading of

liquid drops on porous substrates has received rather less

attention,5,6,7 yet it is, if anything, even more commonplace

and important, e.g., raindrops on textiles, spray paint on

wood, and inkjet droplets on receivers such as paper. The

ink-jet system is especially challenging experimentally,

as the drops are very small, typically in the volume range

4-18 pL, and the receivers vary widely in their properties.

In inkjet printing, drops of ink are projected toward the

receiver surface at velocities in the range 1-5 m/s. On

reaching the surface, the drops start to spread, driven

initially by both inertia and capillary forces (Figure 1).

The Weber number,*We*, describes the ratio of these forces,

and it has been shown8 that for *We* > 50, splashing will

occur. For the inkjet process, *We* is given by

with F the density, *r* the radius, *v* the impingement velocity,

and *ç* the surface tension of the drop. Taking typical values

of F ) 1000 kg/m3, *r* ) 12 *í*m, *v* ) 2 m/s, and *ç* ) 30 mN

m-1,*We*is of order 1. Hence, in the initial spreading phase,

although inertia is important and waves will be seen on

the surface of the drop, no splashing will occur.

IDS CAD Chang’s manual 12 steps

2016

<https://www.idscad.com/wp-content/uploads/2016/11/liquid-brochure-1-1.pdf>

Drop Penetration into Porous Powder Beds

Karen P. Hapgood et al

Imbibition of a single drop into a porous substrate depends

on the structure of the substrate: the porosity, the size of the

pores, the orientation of the pores, and the surface chemistry

within the bed (6). A simple model based on a bundle of parallel

cylindrical capillaries has been derived independently by two

authors (6, 7). Both approaches apply the Washburn equation

where wetting is driven by the capillary pressure and resisted

by viscous dissipation of the flow. The analysis considers only

drop drainage.

The drop penetration time (also called the wicking time (6))

is defined as the time taken for the drop to penetrate completely

into the porous substrate with no liquid remaining on the surface.

In this paper, *τ* indicates a calculated penetration time and *t*p

indicates an experimentally determined penetration time.



The five steps of nucleation. 1, Droplet formation; 2, droplet impact

on the powder and possible breakage; 3, droplet coalescence at the powder

surface; 4, droplet penetration into the powder pores; 5, mixing of the liquid and

powder by mechanical dispersion.

The main difficulty with the existing model (6, 7) is that the

assumption of parallel capillary pores cannot be applied directly

to powder beds. The Kozeny approach employed is commonly

used in powder systems to define an effective pore size based on

properties of the powder,



**FIG. 3.** (a) For close packing powders the fluid drainage is relatively uninhibited. (b) As liquid penetrates into powders containing large macrovoids the liquid

front will tend to halt when the pore radius increases suddenly. This occurs whenever a capillary pore reaches a macrovoid. The macrovoid space does not contribute

to the effective capillary volume or surface area.

Experimental studies of model porous media fluid dynamics

A. P. Yarlagadda\* and A. P. Yoganathan  
  
The three-dimensional, steady flow velocity components

of a viscous, incompressible, Newtonian fluid in model porous media

were measured. The model porous geometries were constructed

from 3 mm glass rods. A laser Doppler anemometer was used to

measure two of the velocity components and the third was calculated

by integrating the continuity equation. The effects of viscous

drag, inertial flow fields and eddy losses in the model were studied.

The results showed that the measured flow was laminar and stable

such that micromixing of the fluid was absent. Inertial flow effects

were absent due to high viscous drag coefficients.

The bulk direction flow fields had no negative velocity fields,

but both vertical and lateral directional velocity fields had

both positive and negative flow fields. There was no vertical flow at top to bottom layers of the flow field, confirmed by

zero vertical velocities at levels 0 and 1.0 of the representative

cell. In the range on Reynolds numbers studied, fluid

mixing was absent in both the models, although the fluid

follows a tortuous path.

The Point Spread Function and

Optical Dot Gain

Geoffrey L. Rogers





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