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Superhydrophobic Coatings on Asphalt Concrete Surfaces: Towards Smart Solutions for Winter Pavement Maintenance

Background

- Ice formation and snow accumulation on paved areas of airfields and roadways can cause serious problems leading to economical loss, and endangering passenger safety
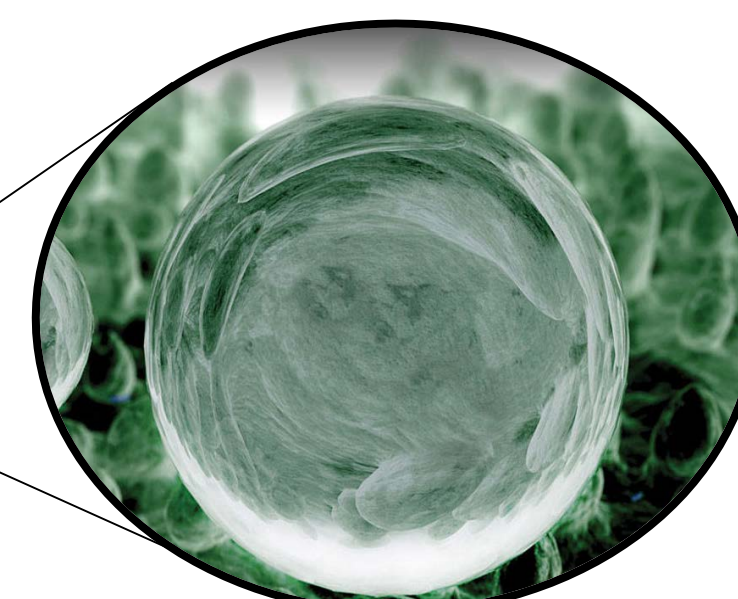

www.vosizneias.com

Courtesy: CNN

- Paved areas with water repellent surfaces mimicking lotus leaves found in nature can minimize ice formation or snow accumulation
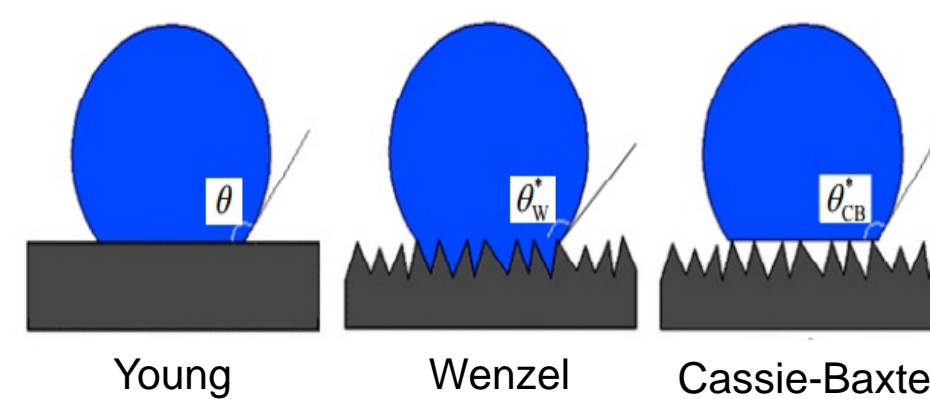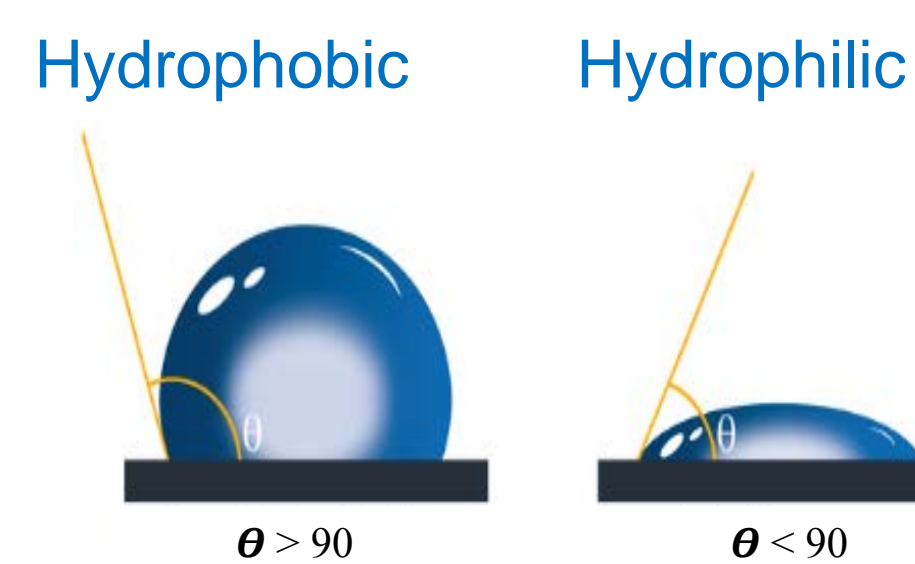

www.flickr.com

www.roadandtrack.com

- Contact angle concept

Hydrophobic   Hydrophilic

$\theta > 90$ $\theta < 90$

- Types of Models explaining the hydrophobicity

Young   Wenzel   Cassie-Baxter
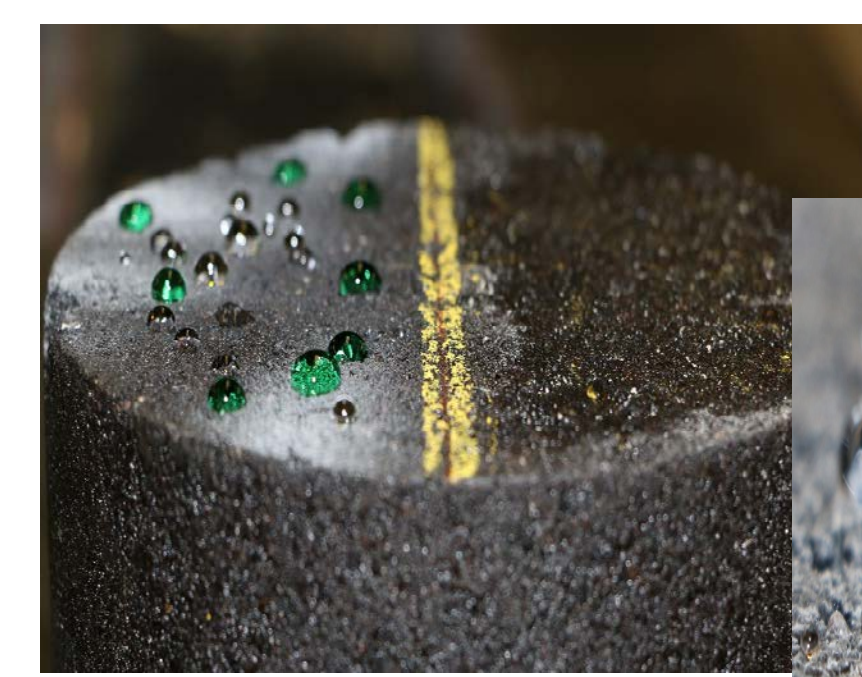
- Coated paved areas must be skid resistant
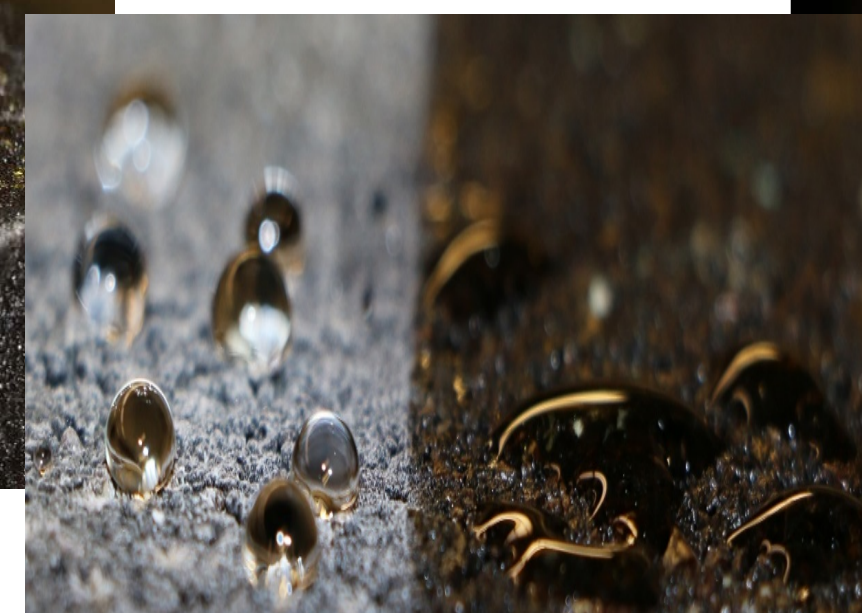

www.lapsset.go.ke
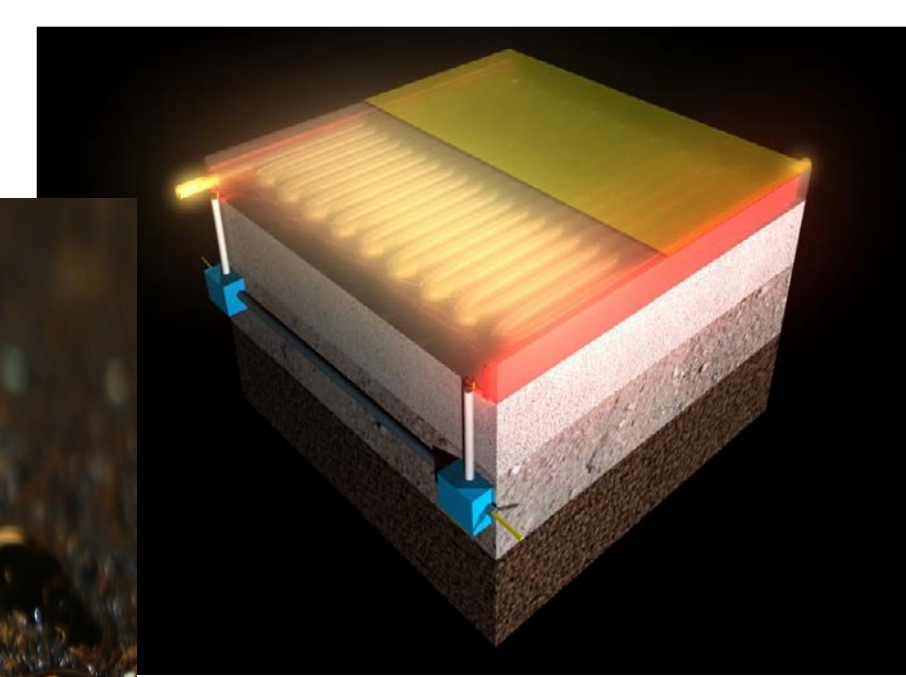
www.powerlanecorporation.com

Applications

- The superhydrophobic coatings can be utilized in:
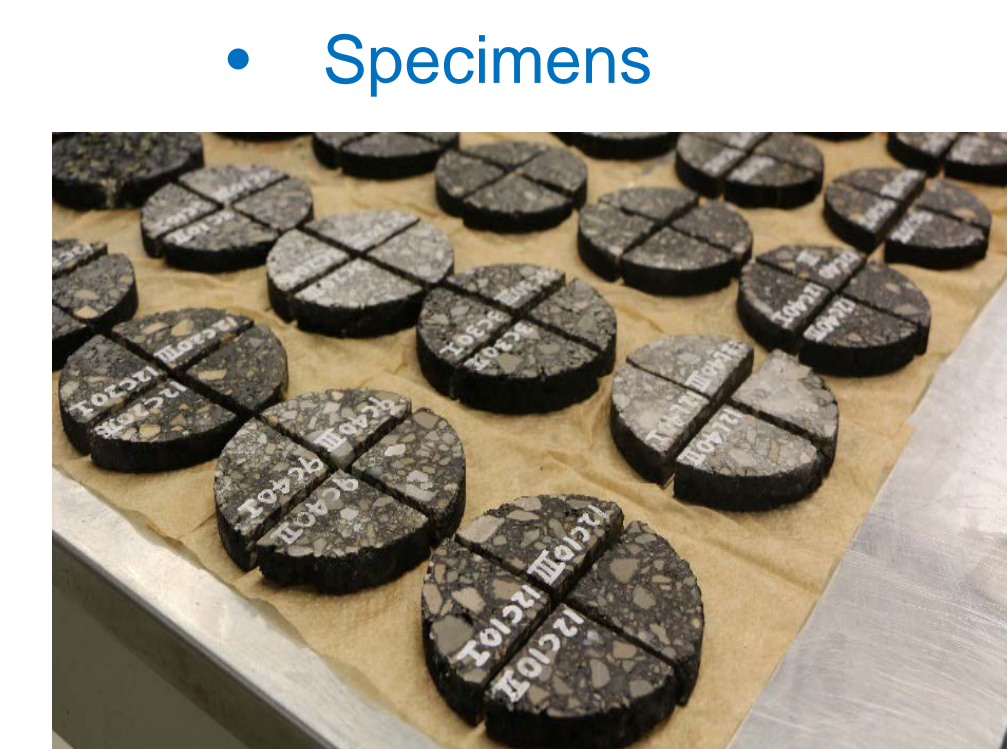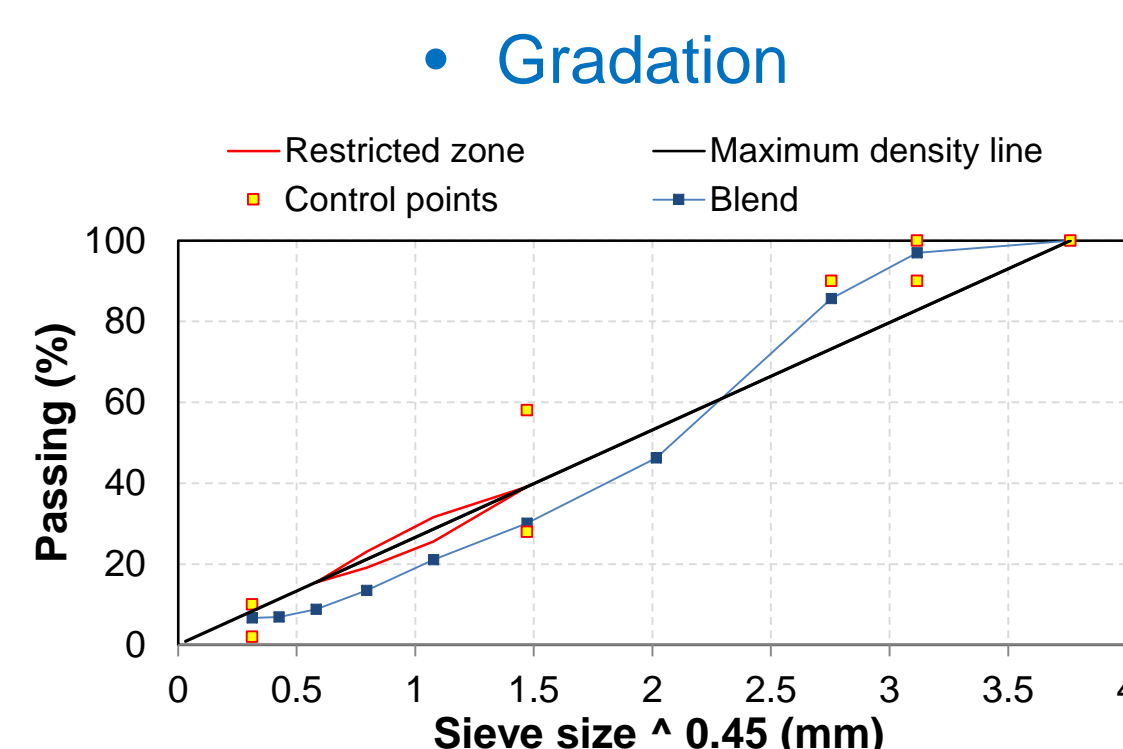

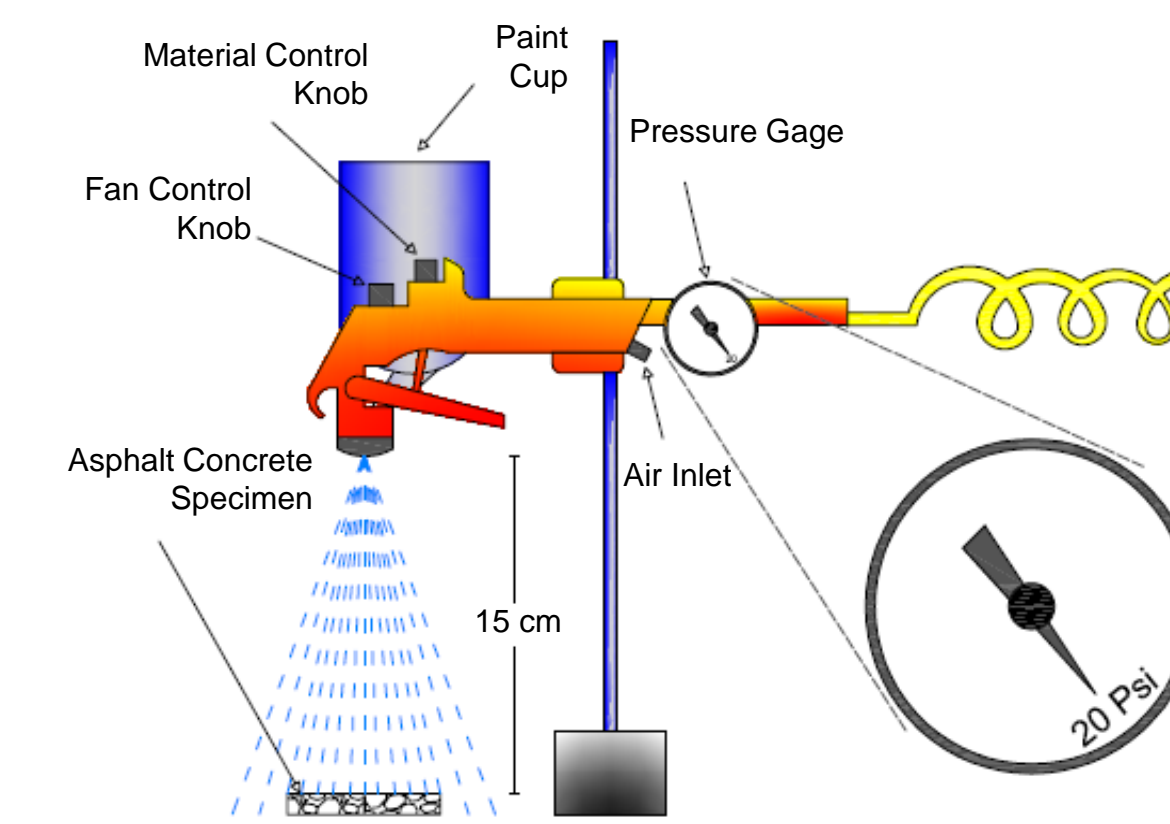Coated Vs Uncoated asphalt concrete

Close up view
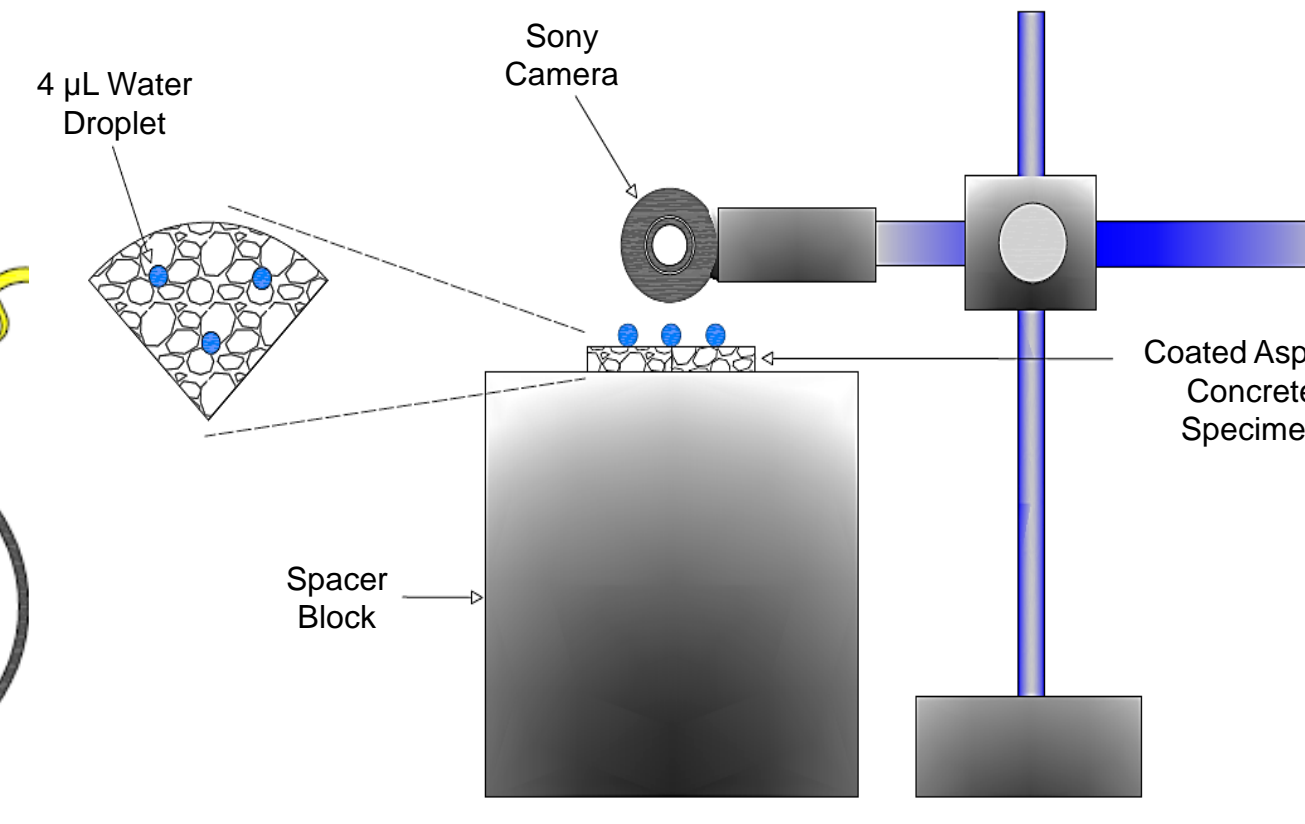
Coated heated runway

Research Approach

- After performing a statistical design, the samples coated with PTFE were prepared, and tests were performed:
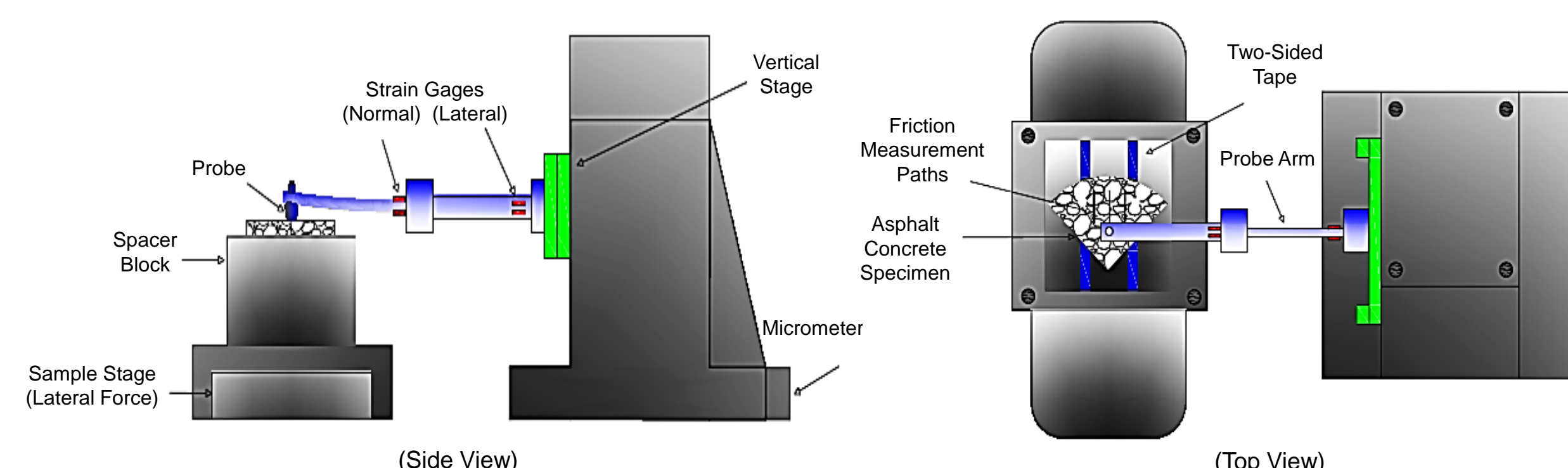
- Gradation

- Specimens

- Spray depositing the epoxy and PTFE

- Contact angle measurement

- Measurement of coefficient of friction
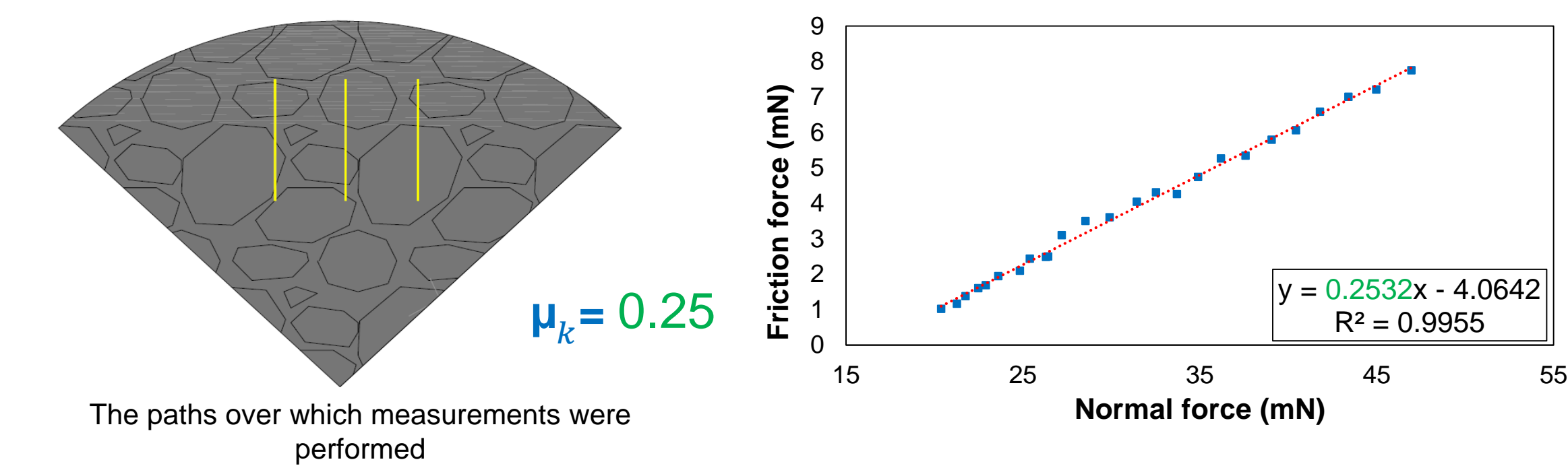

(Side View)   (Top View)

Results

- Capturing and measuring the water contact angles

$\alpha = 154°$ $\alpha = 161°$ $\alpha = 160°$
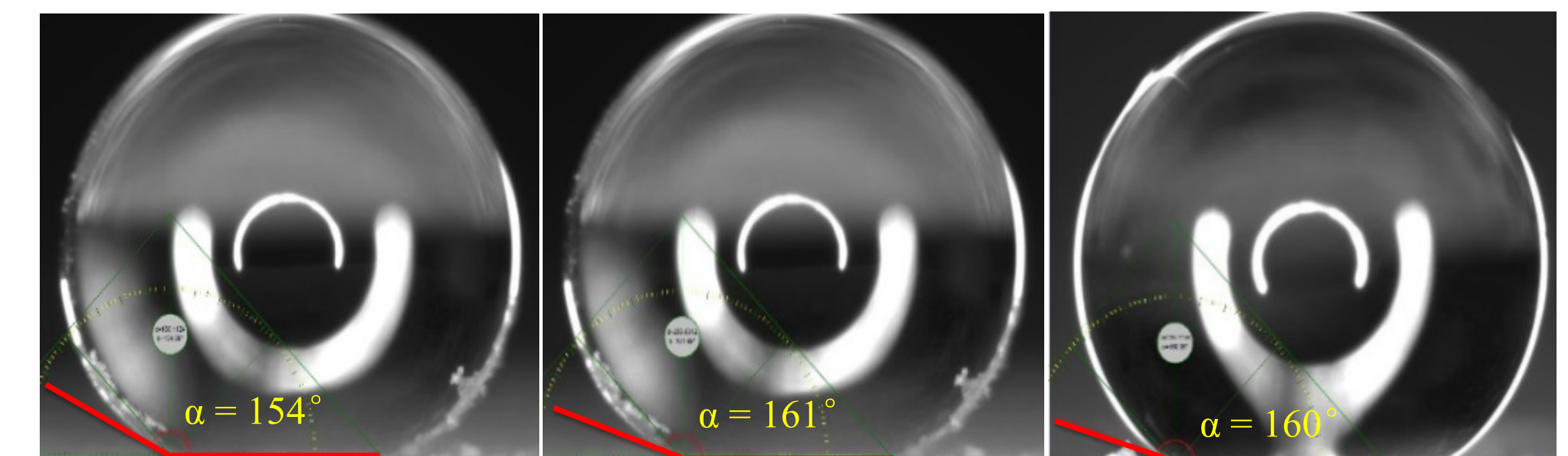
Three measured water contact angles

- Calculating the coefficient of friction

$\mu_k = 0.25$

The paths over which measurements were performed

$y = 0.2532x - 4.0642$
$R^2 = 0.9955$

- Significant factors affecting superhydrophobicity

2-way ANOVA	
Factors	P-value
Dosage (%)	0.016
Spray time (s)	0.0002
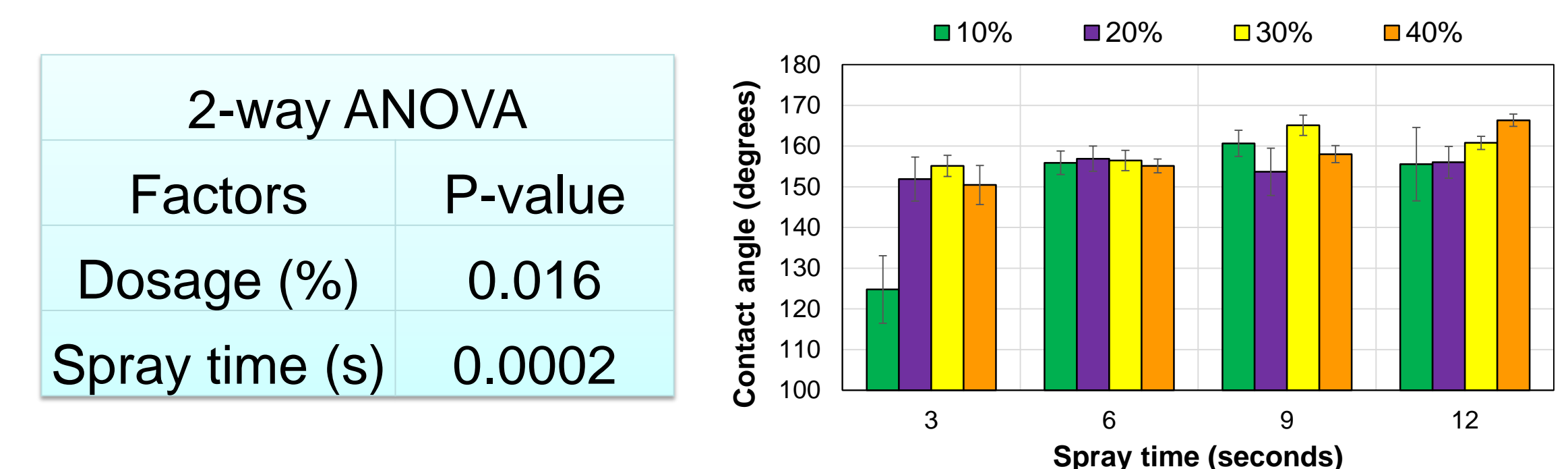
- Significant factors affecting skid resistance

2-way ANOVA	
Factors	P-value
Dosage (%)	0.001
Spray time (s)	0.0001
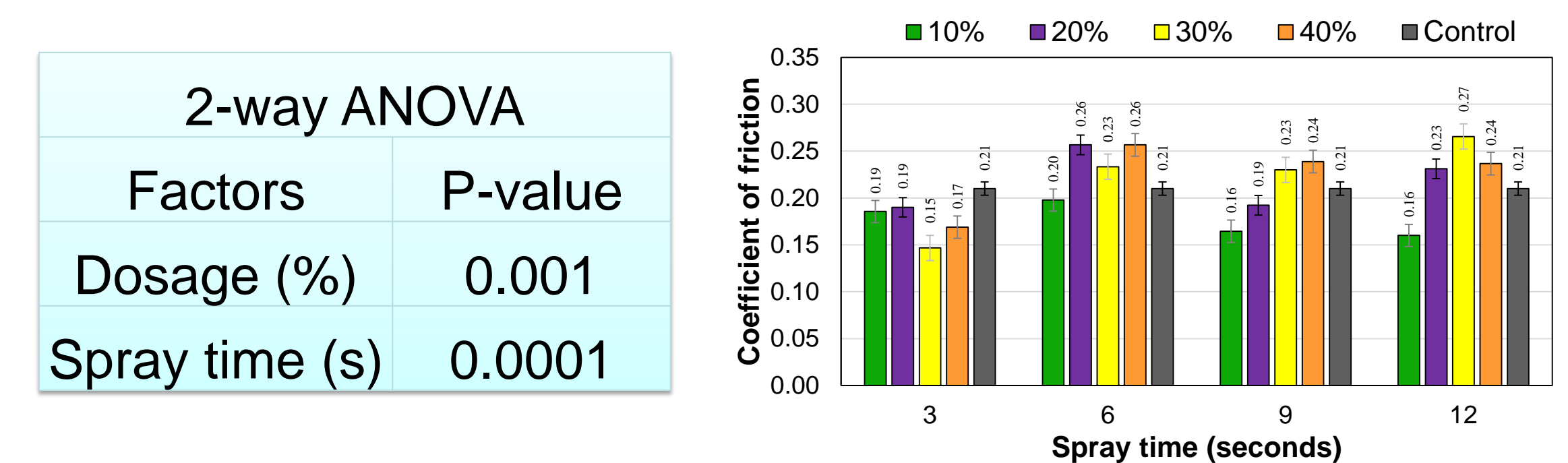
Research Outcome

The PTFE spray time and dosage were significant factors affecting both the superhydrophobicity and skid resistance of nano-coted asphalt concrete; the spray time of six seconds resulted in obtaining skid resistant surfaces.