Effect of UH-Biosurfactant on the performance of Smart Cement

Shivam S. Bhatia and C. Vipulanandan[1], Ph.D., P.E.
[1]Center for Innovative Grouting Material and Technology (CIGMAT)
Department of Civil and Environmental Engineering
University of Houston, Houston, Texas 77204-4003
E-mail: cvipulanandan@uh.edu Phone: (713) 743-4278

Abstract: The long term (28 days) electrical and piezoresistive properties for Smart Cement (water to cement ratio 0.4) prepared by adding laboratory made Biosurfactant (UH-BS) were studied. 1.25% by weight of cement (bwoc) of UH-BS was added which increased the initial, minimum 1 day and 28 day resistivity of smart cement. Adding UH-BS also reduces the compressive strength and the piezoresistive sensitivity of the smart cement.

1. Introduction:

Cement and polymer grouts are being used in various construction and rehabilitation applications related to oil wells, piles, structures, leaking pipelines and ground improvement (Vipulanandan et al., 2016). Biosurfactants are versatile products with vast applications in the food, pharmaceutical, and other industries which led to the continued interest in biosurfactants (Olasanmi, I., et al., 2018). Studies have also proven that Surfactants helps to reduce the density of the grout by forming air voids which are entrained in the cement paste using surfactants (Kligys et al., 2007).**2. Objective**: The overall objective was to experimentally determine and quantify the bentonite cleaning efficiency of nanoiron oxide based smart spacer fluid.

2. Objectives:

Monitor the effect of UH-BS on the electrical and piezoresistive properties of smart cement for upto 28 days of curing.

3. Materials and Method:

In this study, smart cement samples were prepared with water to cement ratio of 0.4, with 0.05% of conductive filler and 1.25 bwoc UH-BS. Samples were prepared by mixing conductive filler in water followed by UH-BS with cement being added in the surfactant solution by hand mixing. Specimens were prepared in cylindrical molds of height 4 inches in height and 2 inches in diameter. Wires were inserted in

4. Results and Discussion

The optimal dosage of UH-BS was selected on the basis of initial resistivity, compressive strength and piezoresistive sensitivity for 1 day of air curing. For smart cement grout with 1.25% of UH-BS, piezoresistivity at peak compressive stress was 158.12% (1360 psi) which switched to 147.12% (1335 psi) and 139.12% (1090 psi) for 0.75% and 2.5% of UH-BS respectively.

4.1 Resistivity

Long term effect of UH-BS on electrical and piezoresistive properties of Smart Cement (SC) was studied and compared with standard Smart Cement sample. Studies show that initial and minimum resistivity of standard smart cement was 0.96 Ω m and 0.89 Ω m (at 140 mins) respectively which increased to 1.17 Ω m and 1.03 Ω m (at 165mins) with the addition of 1.25% of UH-BS. After 1 day and 28 days of curing, resistivity of smart cement grout was 3.34 Ω m and 15.64 Ω m respectively, which increased to 4.17 and 34.36 Ω m for UH-BS smart cement sample. (Fig. 1)

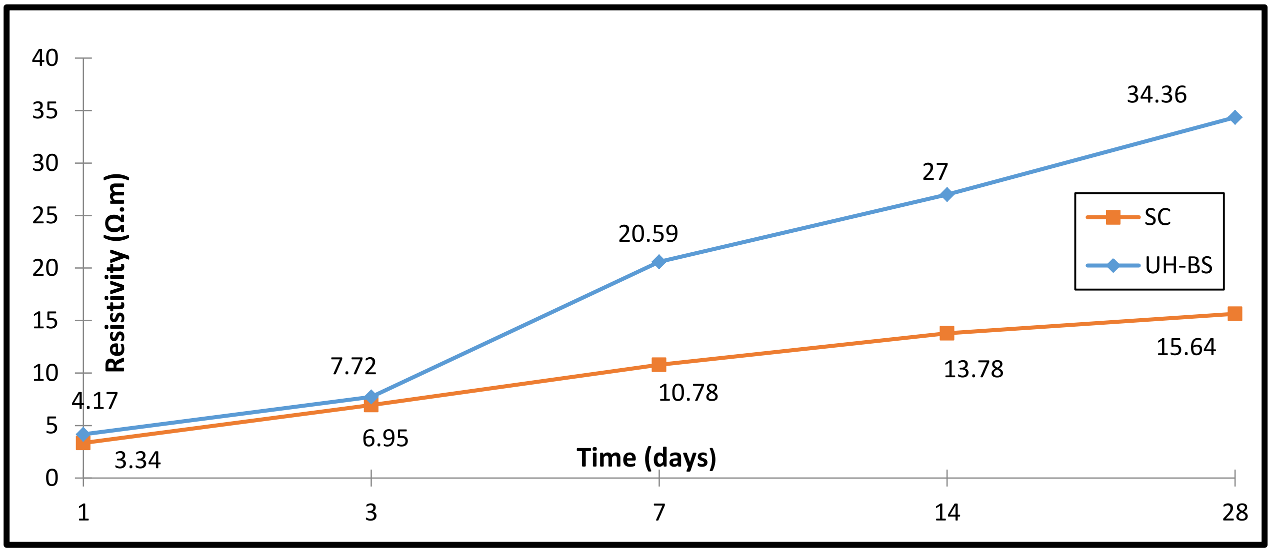

Fig – 1. Resistivity of Smart Cement with and without UH-BS

4.2: Compressive strength and Piezoresistivity:

Piezoresistive response for standard smart cement sample (Fig.2 & 3) at 1 day and 28 days of curing was 212% and 176% whereas addition of 1.25% of UH-BS reduced the piezoresistivity to 158% and 101% respectively. Addition of UH-BS also showed similar pattern on peak compressive stress. Addition of UH-BS also reduced the compressive stress by 12.25% and 23.66% after 1 day and 28 days of curing.

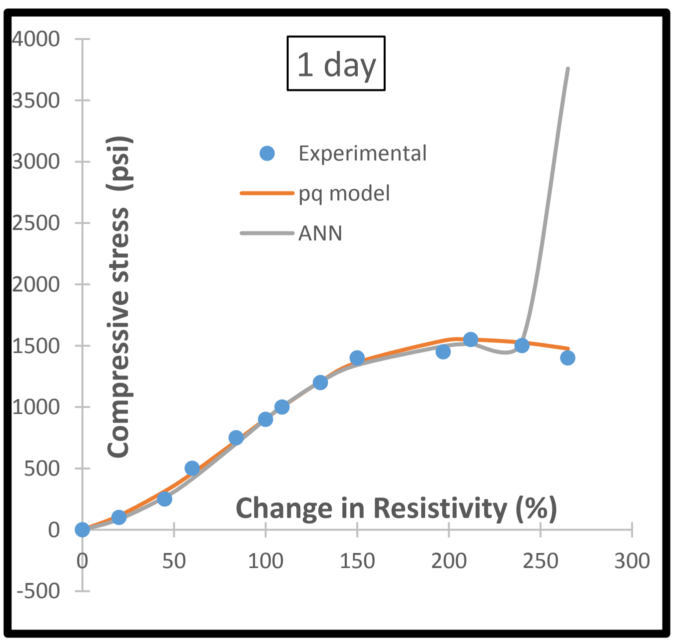

Fig – 2. Compressive strength vs piezoresistivity of standard smart cement at 1 day of curing

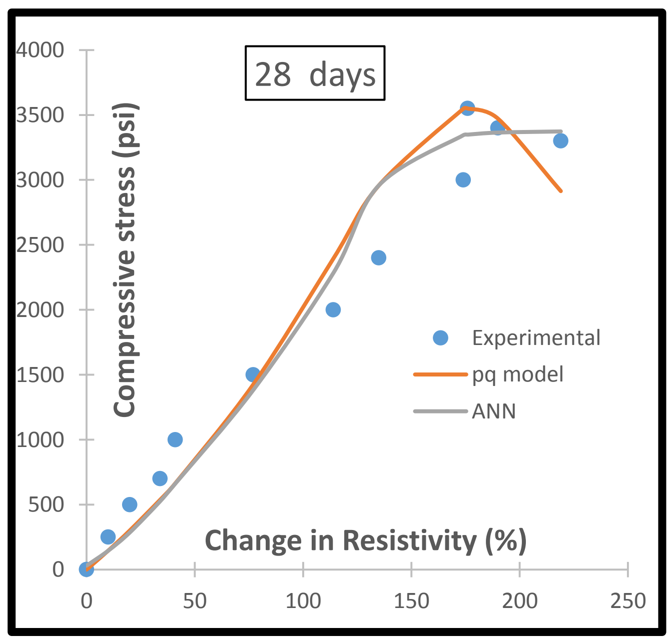

Fig – 3. Compressive strength vs piezoresistivity of standard cement at 28 days of curing

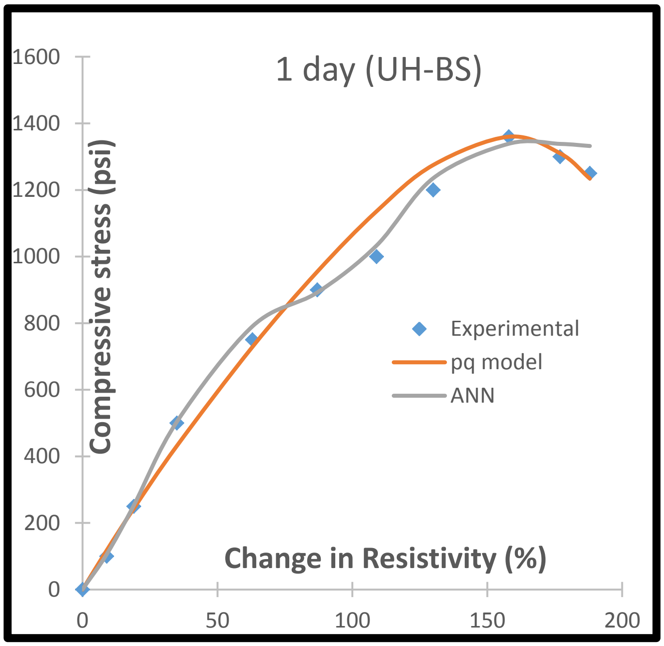

Fig – 4. Compressive strength vs piezoresistivity of smart cement (UH – BS)at 1 day of curing

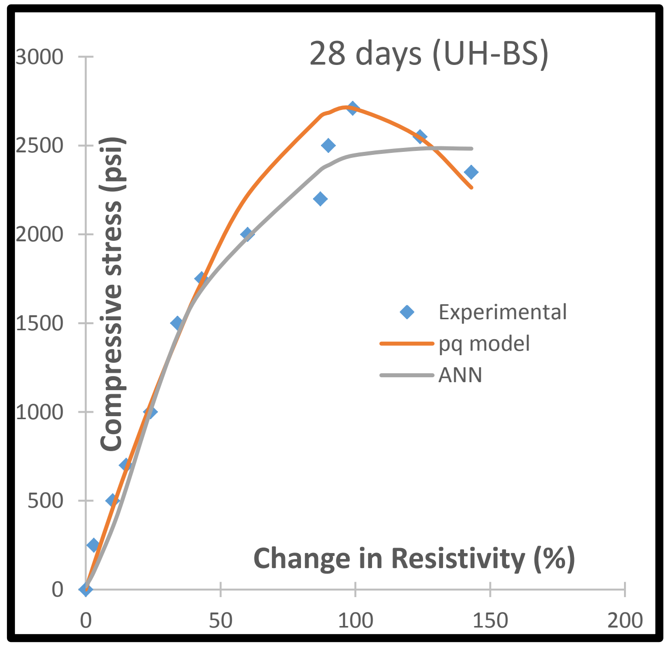

Fig – 5. Compressive strength vs piezoresistivity of standard cement (UH – BS) at 28 days of curing

Above figures represent the piezoresistive behavior of standard smart cement sample (with and without UH-BS) at 1 and 28 days of curing. The experimental data have been plotted with Vipulanandan p-q model and also compared with Artificial Neural Networks (ANN). Various orders of hidden layers were used for analysis by Artificial Intelligence. It was found by 3rd order of ANN provided the most accurate prediction.

Table – 1. Details for vipulanandan pq model and ANN

		Vipulanandan p-q model				**ANN**
	Days of curing	p2	q2	R2	RMSE	RMSE
SMART CEMENT	1	0.38	0.51	0.99	21.88	71.42
	28	0.16	0.62	0.99	17.24	17.2
UH – BS	1	0.4	0.31	0.99	12.12	21.45
	28	0.3	0.59	0.98	17.50	23.42

5. Conclusion

1. Adding Biosurfactant increased the initial and minimum resistivity by about 18% and 14% respectively. Also, the 24hr resistivity increased by 20% followed by 54% for 28 days of curing.
2. The addition of Biosurfactant affected the piezoresistive behavior and compressive strength of the smart cement. The piezoresistivity of smart cement with UH-BS decreased by 25% and 42% whereas the compressive strength decreased by 12 and 23% respectively for 1 day and 28 days of curing respectively as compared to those of standard smart cement grout.

6. Acknowledgements
This study was supported by the CIGMAT (Center for innovative grouting materials and Technology) and Texas Hurricane Center for Innovative Technology (THC -IT), University of Houston, Houston, Texas.

7. References
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