



Using Biochar in Concrete

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Program Director

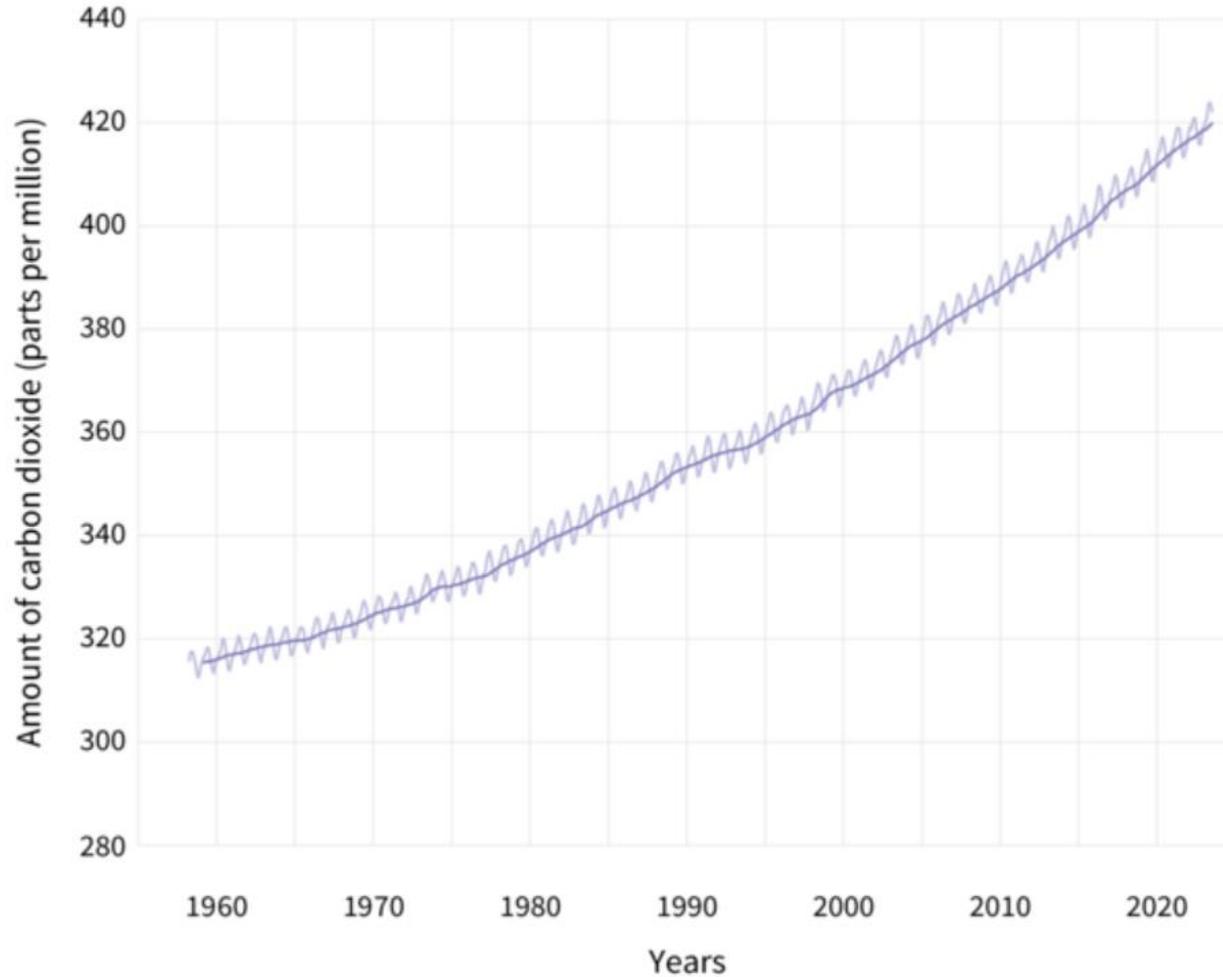
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ATMOSPHERIC CARBON DIOXIDE



What is Biochar?



subjecting biomass (organic matter, such as wood, food waste, agricultural waste) to high temperatures (often over 400C) in an environment with little oxygen (Pyrolysis)

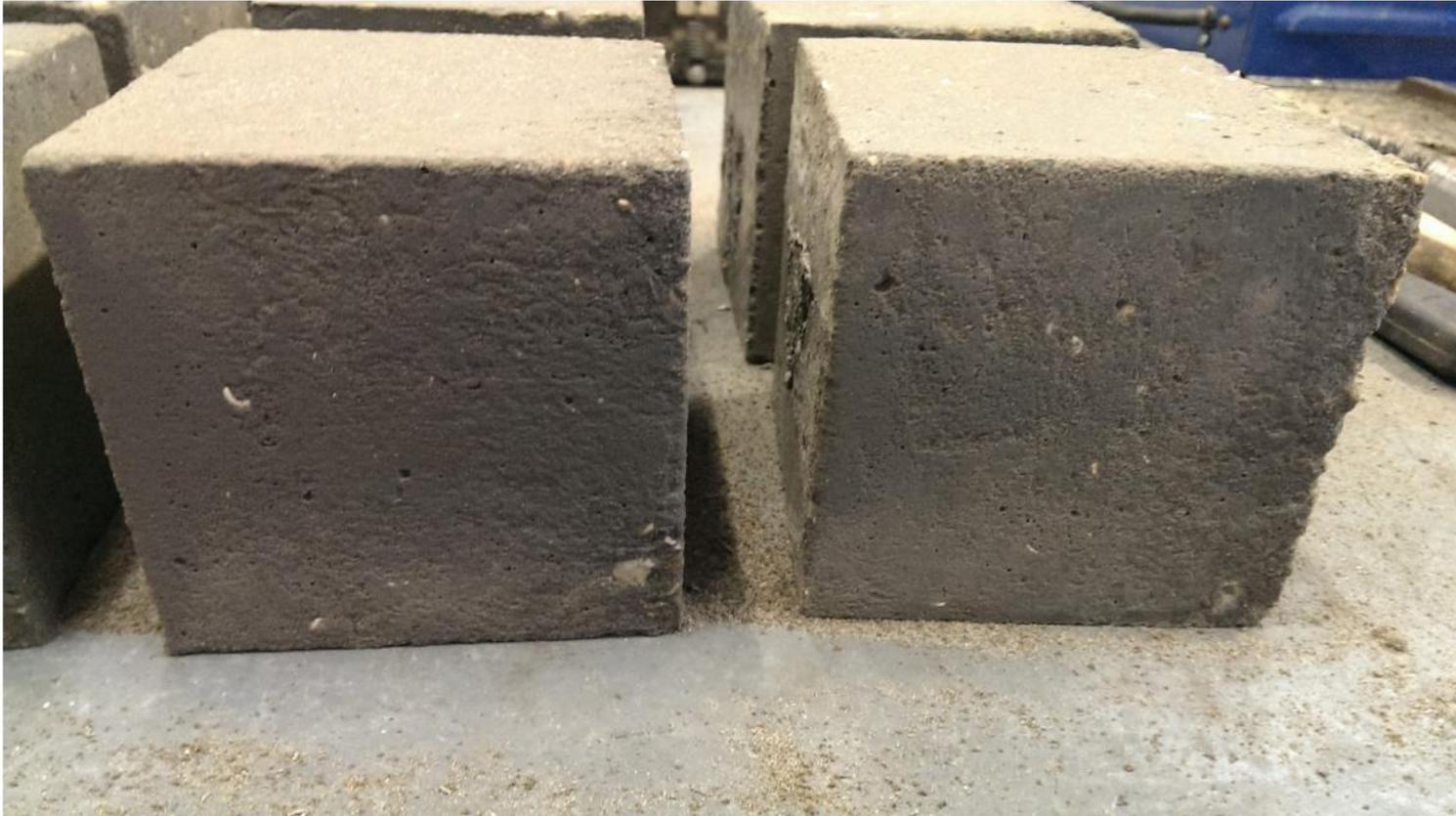
General Use of Biochar?

- (1) Soil Amendment*
- (2) Carbon Sequestration (Carbon Sink)*
- (3) Water Treatment*
- (4) Livestock Food Additive*
- (5) Composting*
- (6) Oder Control*

How about adding it to concrete?

- (1) Enhance properties (strength and durability)*
- (2) Reduce Cracking*
- (3) Resist Corrosion*
- (4) Reduce Weight*
- (5) Reduce Maintenance Cost*
- (6) Sustainability & Carbon Sequestration*

Dual Advantage!



Graphene-reinforced concrete is "more than twice as strong" say scientists

Solais Ventures



New Jersey Department of
Transportation

Pilot Study (\$25,000)

Concrete Properties?

- (1) Workability*
- (2) Air Content*
- (3) Density*
- (4) Strength*

Replacement (weight, or Volume)?

- (1) Aggregate (Fine/coarse)*
- (2) Cement*

Base Mix (100% Portland Cement)

Component	Units	Weight	Specific Gravity
Cement	lbs./CY	660	3.15
Fly Ash	lbs./CY	0	2.50
Coarse Aggregate	lbs./CY	1719	3.01
Normal Fine Aggregate	lbs./CY	1390	2.636
Biochar	lbs./CY	0	1.16
Water	lbs./CY	320	1.00
W/C	N/A	0.48	

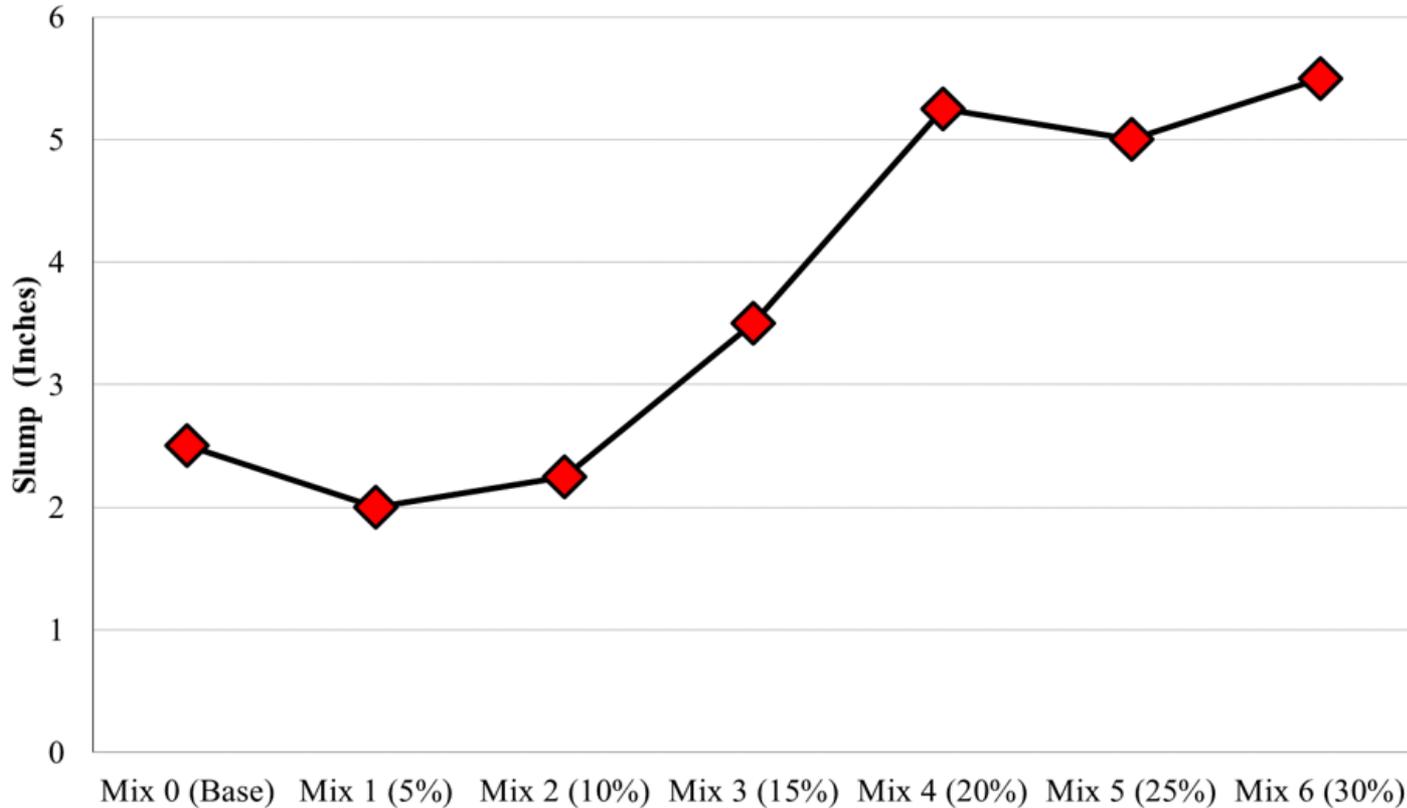
Fresh and Hardened Concrete Tests

Parameter	Test Method	Material State
Slump	ASTM C143/C143M	Fresh
Air Content	ASTM C231/C231M	
Density	ASTM C138	
Compressive Strength at 7, 21, 28, and 56 days	ASTM C109/C109M	Hardened

Biochar Replaces Fine Aggregate (Weight)



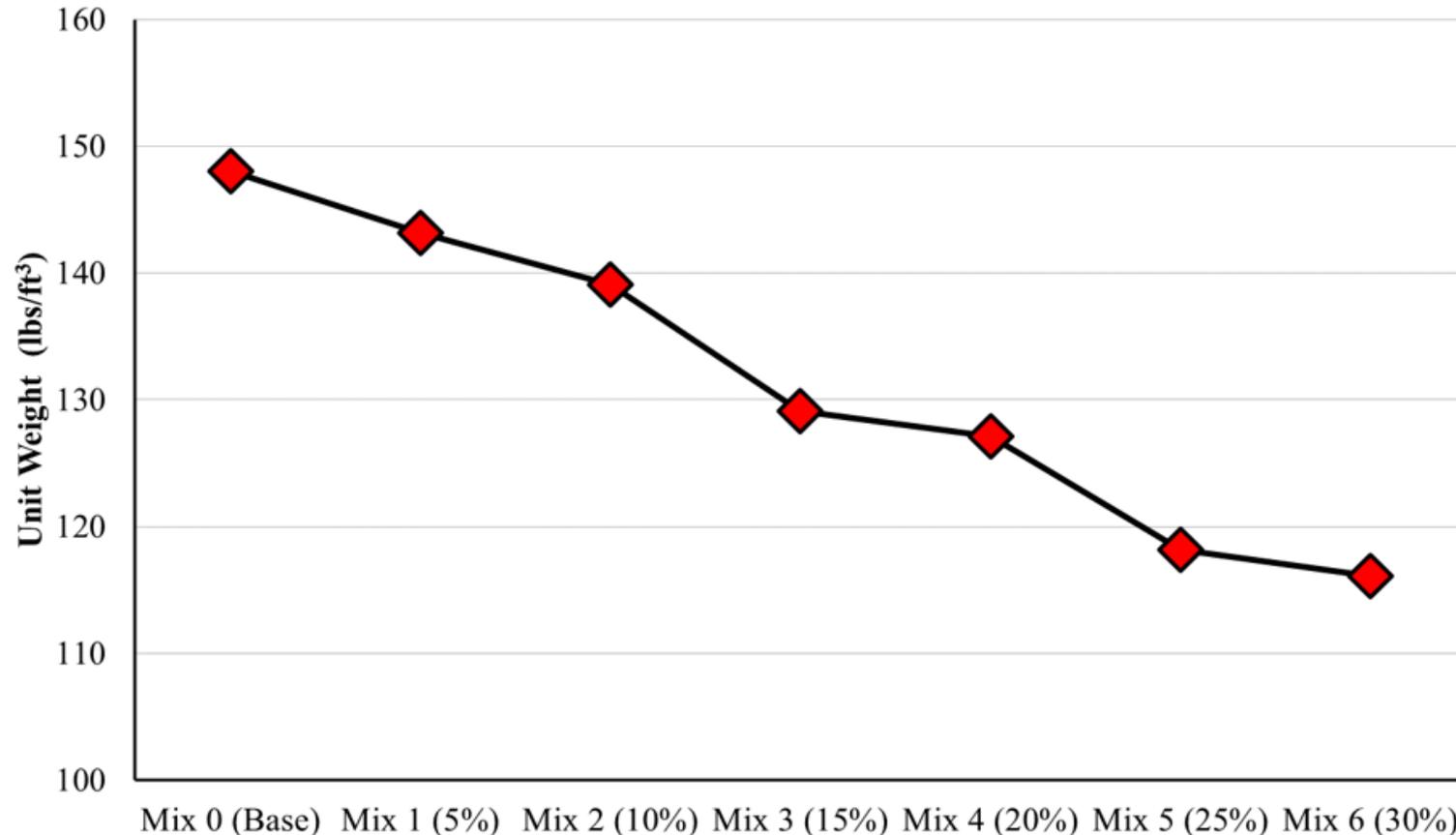
Sump Test Results



Biochar Replaces Fine Aggregate (Weight)



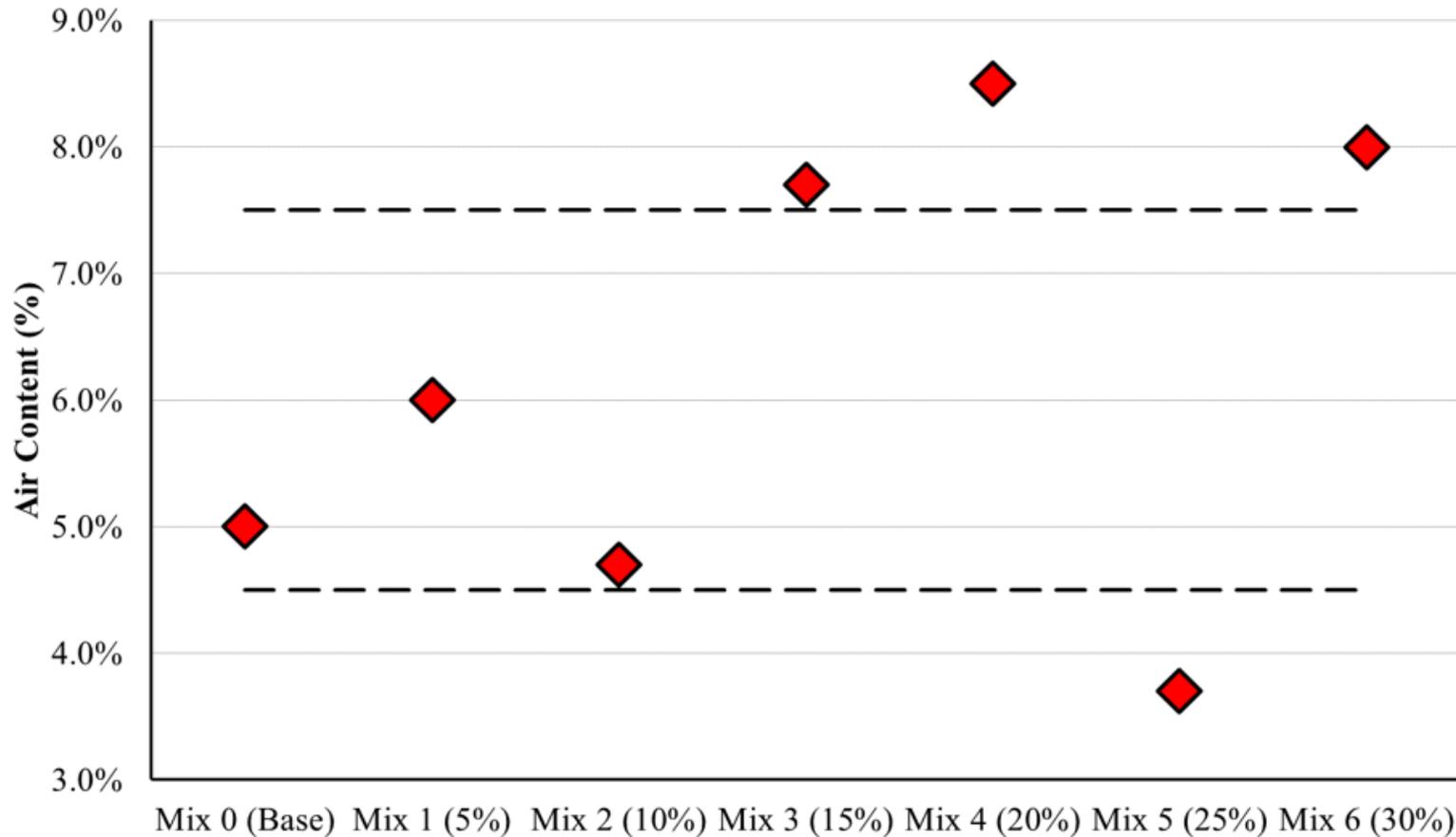
Density Test Results



Biochar Replaces Fine Aggregate (Weight)



Air Content Test Results



Compressive Strength Test Results

NJDOT Strength Specifications



Table 903.03.06-3 Mix Design Requirements

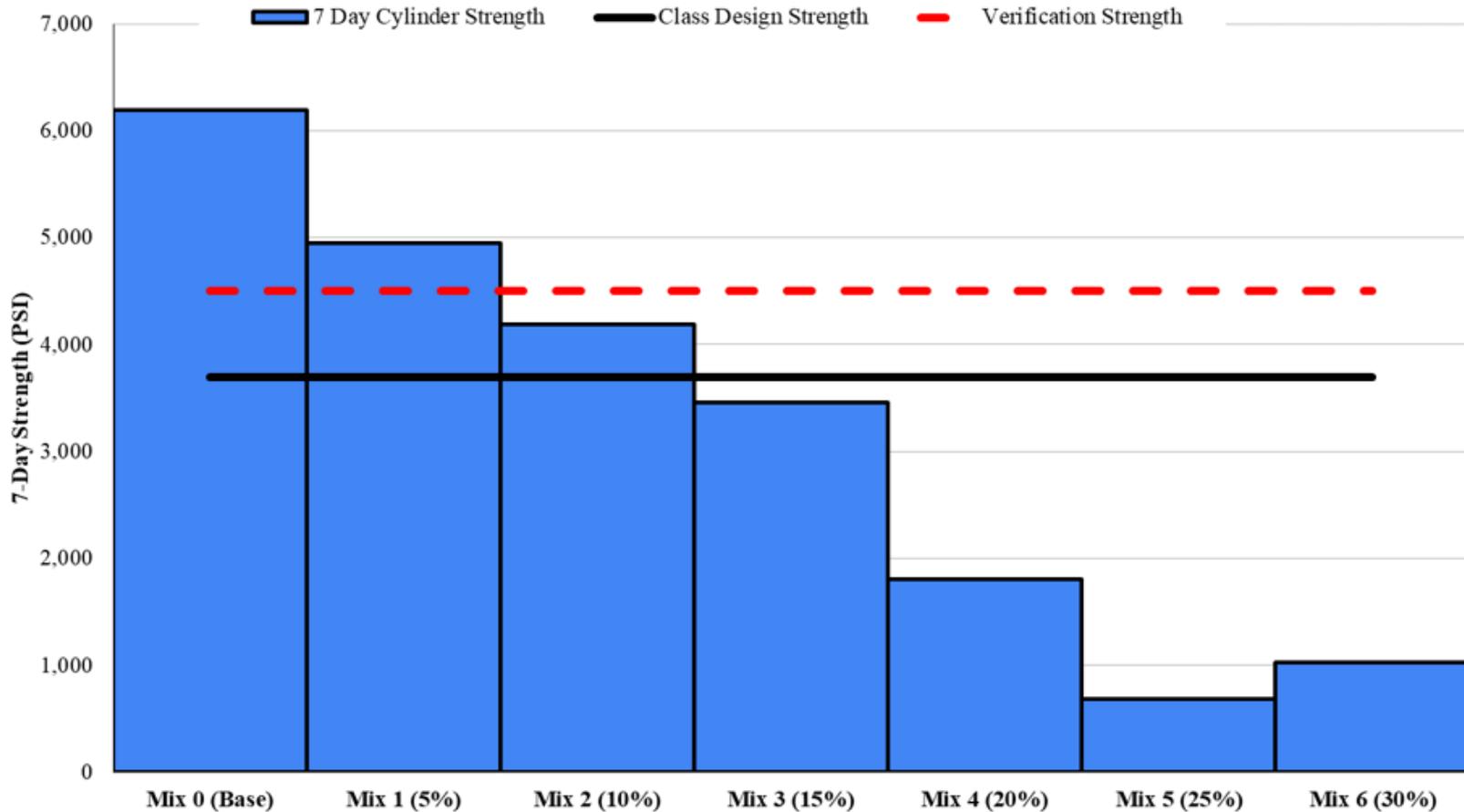
	Class A	Class B	Class S	Class P	Class P-1	Class P-2
Class Design Strength ² (28 days, psi)	4600	3700	2000	5500	6000	6500
Verification Strength ² (28 days, psi)	5400	4500	–	6000	6500	7000
Maximum Water-Cement Ratio ³ (lb/lb)	0.443	0.488	0.577	0.400	0.400	0.400
Minimum Cement Content (lb/cy)	611	564	658	1	1	1

1. According to *PCIMNL-116*.
2. Record all concrete test results to the nearest 10 psi.
3. When a Type F or G water-reducing, high range admixture is used as specified in [Table 903.03.06-1](#) and [Table 903.03.06-2](#), reduce the maximum water-cement ratio by 0.043 for all classes of concrete except for Classes P, P-1, and P-2.

Biochar Replaces Fine Aggregate (Weight)



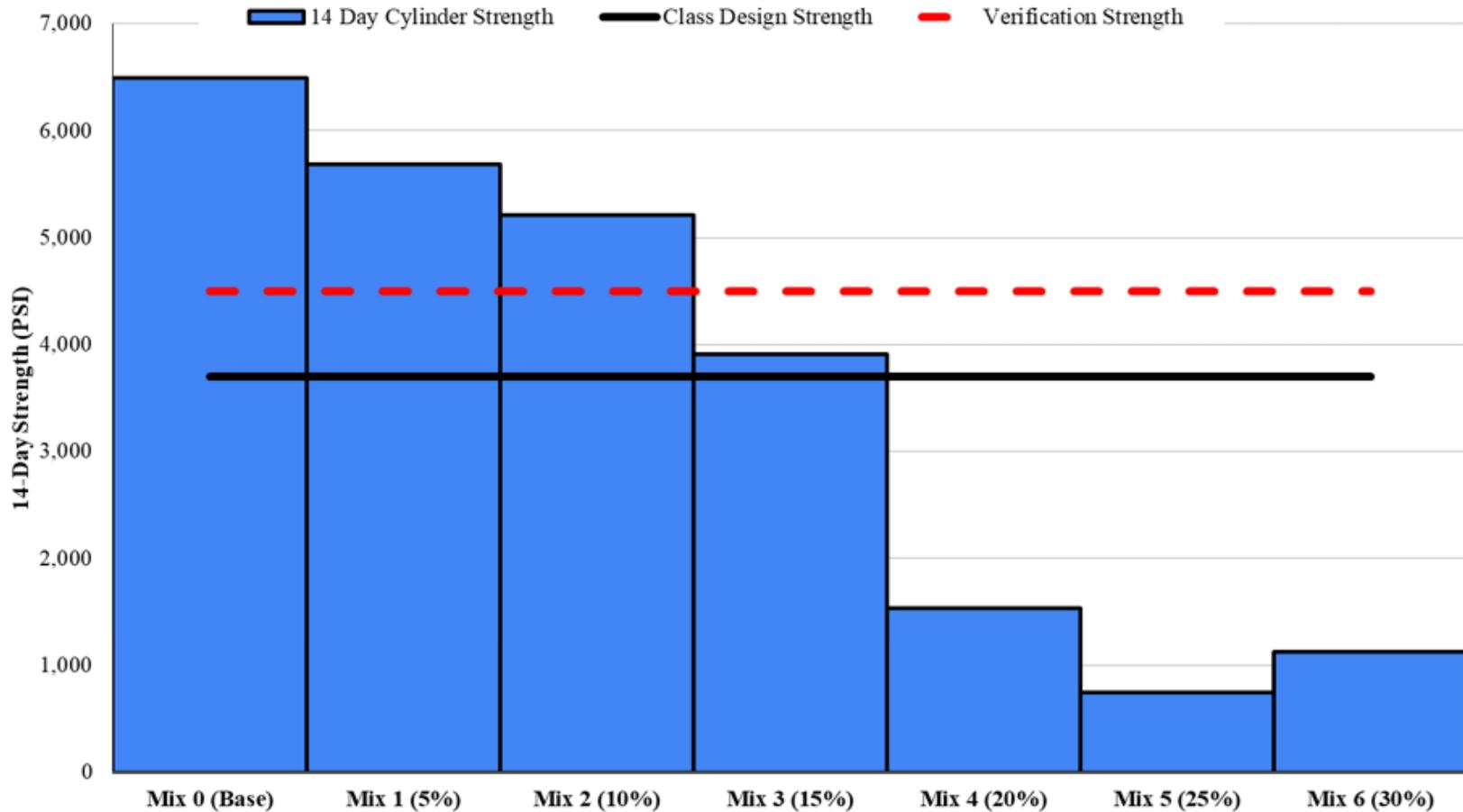
Compressive Strength Test Results



Biochar Replaces Fine Aggregate (Weight)



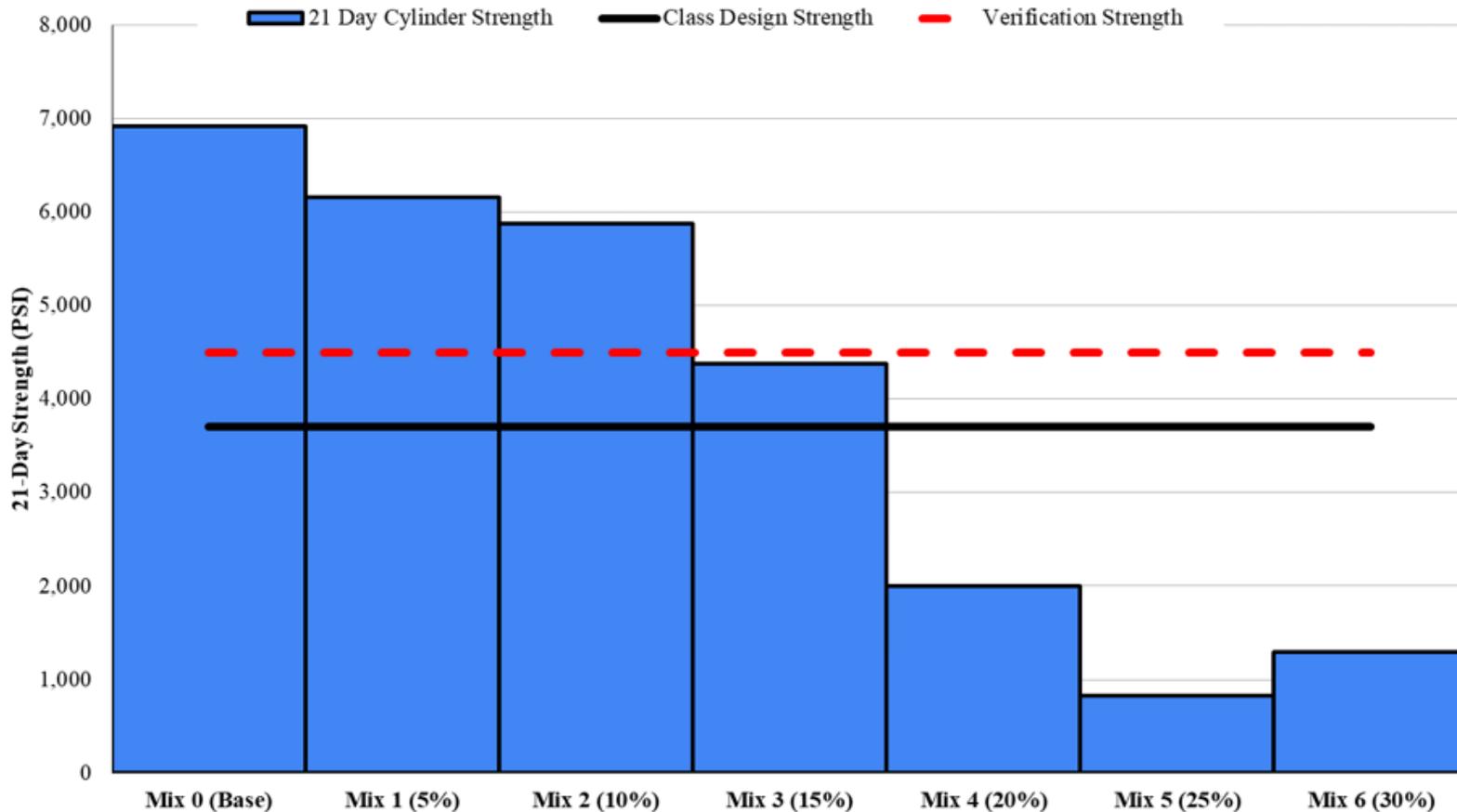
Compressive Strength Test Results



Biochar Replaces Fine Aggregate (Weight)



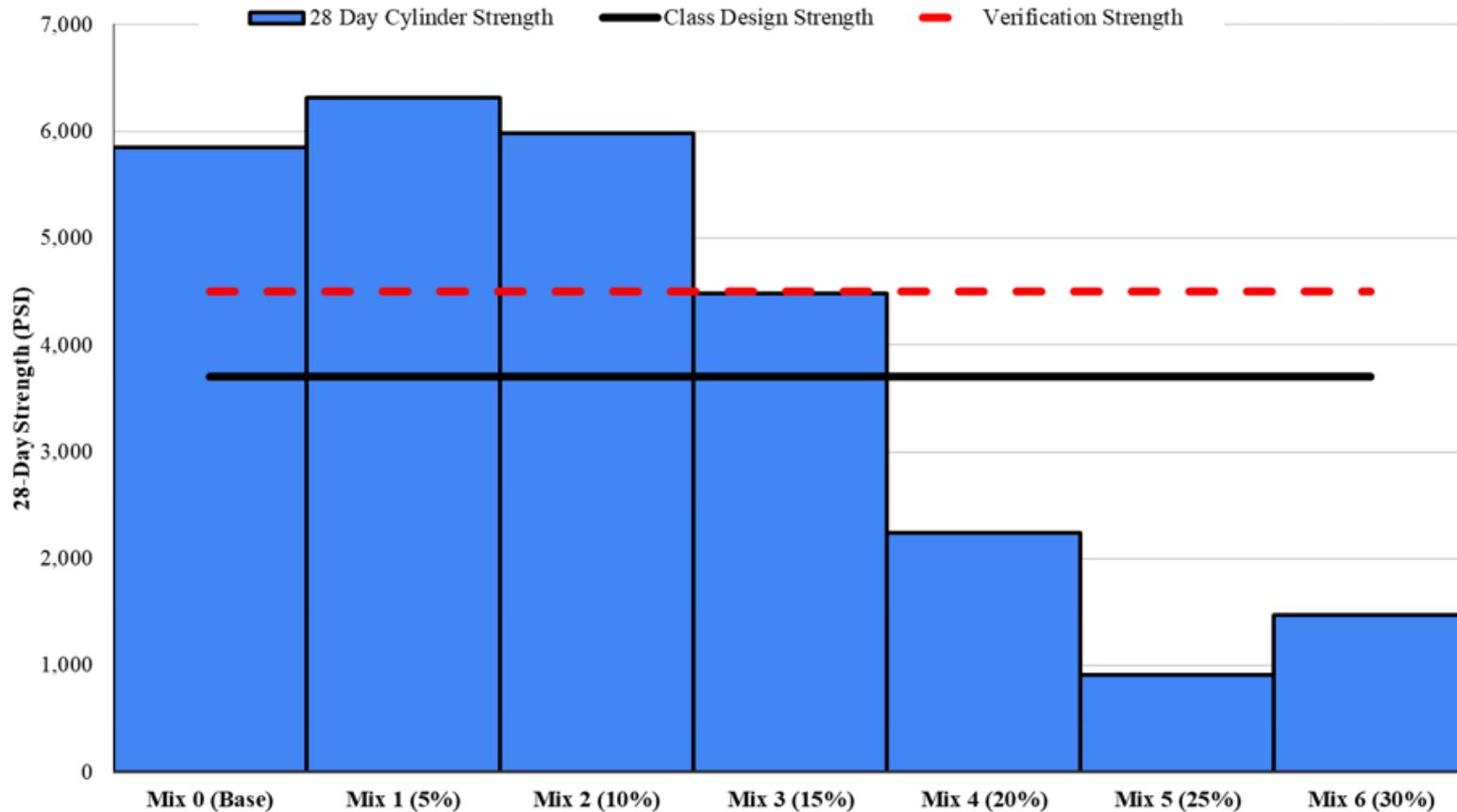
Compressive Strength Test Results



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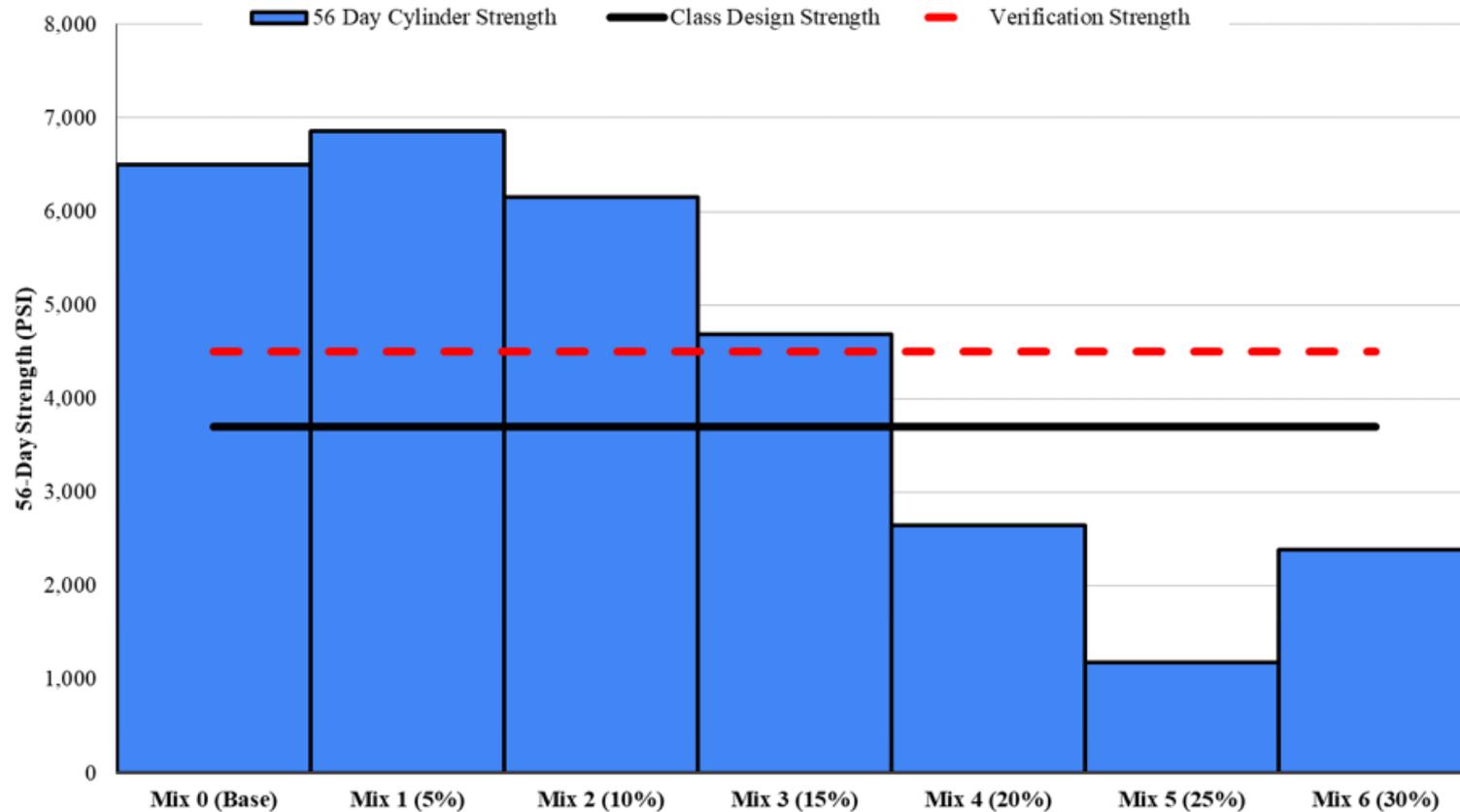
Compressive Strength Test Results



Biochar Replaces Fine Aggregate (Weight)

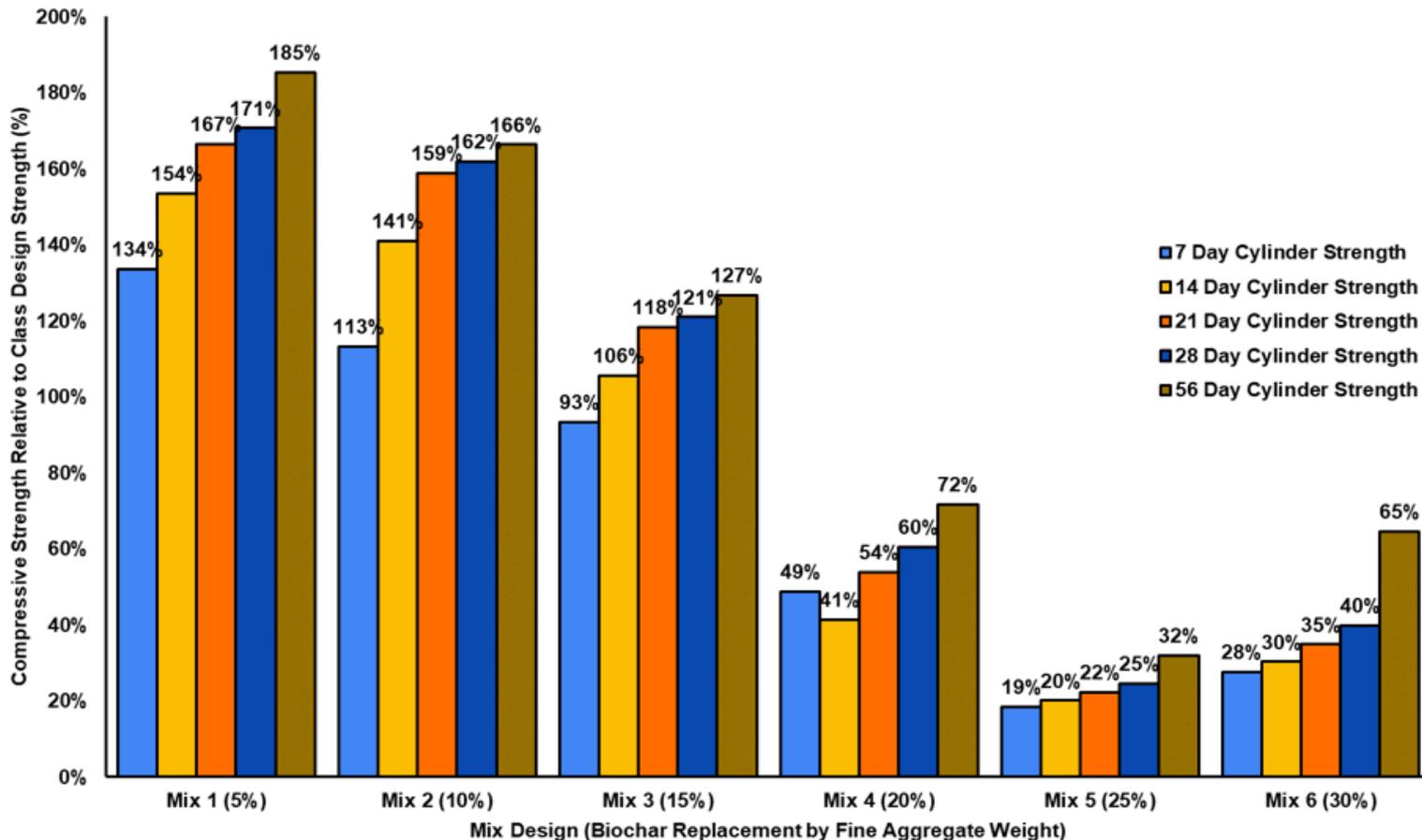


Compressive Strength Test Results



Biochar Replaces Fine Aggregate (Weight)

Compressive Strength Test Results



Future Work (Sought Extra Fund)



- (1) Cement Replacement (Fine Biochar)*
- (2) Both Fine Aggregate and Cement Replacement*
- (3) Environmental Life Cycle Assessment (LCA)*
- (4) Durability Assessment of (1) and (2)*

Solais Ventures



New Jersey Department of
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Thank you