Climate Resilient Solutions For Hamilton Bicycle Infrastructure

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PROBLEM

How might we reduce construction and maintenance costs for new bicycle lanes while making them more resilient to climate change?

- **Funding Challenges:** Hamilton must double its current road maintenance budget to maintain roads at a "C" level, according to the Hamilton Spectator report. [1]
- **Material Costs:** Traditional concrete and asphalt are reliable but costly to install and maintain, requiring frequent repairs. Their production also generates significant greenhouse gas emissions—hot mix asphalt, for example, produces 65.8 kg of CO_2 per kilometer. [2]
- **Climate Change Impact**: Climate change is expected to increase maintenance costs due to more frequent extreme weather events. The Financial Accountability Office of Ontario estimates these costs could rise by **$1.5 billion annually** across the province this decade. [3]

SOLUTION

After extensive research, I have identified a solution for climate-resilient bicycle infrastructure: **a thermal insulation coating or an innovative bike lane material incorporating EP-GHB mixed ceramsite.**[4]

➢ **What is it made of?**

- **Expanded Perlite (EP) and Glazed Hollow Bead (GHB):** Main thermal insulation materials.
- **Ceramsite and Sand:** Used as aggregates.
- **Glass Fiber:** Included for strength and durability.
- **Sodium Dodecyl Sulfate:** Used in the formulation of the coating.

➢ **Why should we use EP-GHB Mixed Ceramsite?**

- **Thermal Insulation:** Reduces heat/cold buildup, keeping roads cooler and improving comfort.
- **Moisture and Frost Protection:** Prevents moisture absorption and frost, enhancing road durability.
- **Lightweight and Durable:** Provides strength without adding excessive weight, ensuring long-lasting roads.
- **Cost-Effective:** Offers an affordable, easy-to-apply solution with high thermal efficiency.

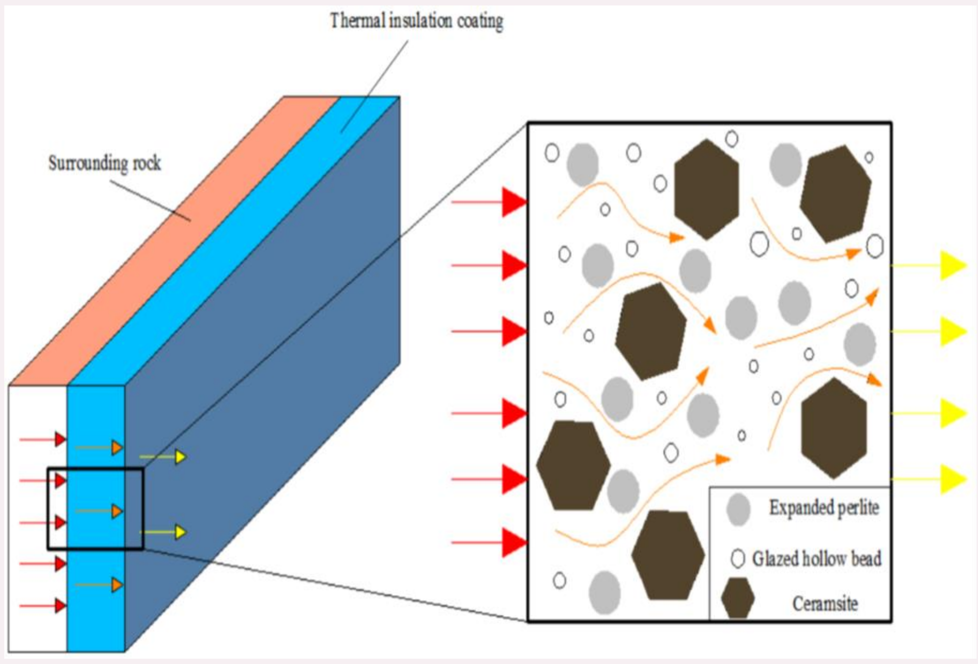

Table 8 Efficiency coefficient analysis data

	Efficacy index				Efficiency coefficient				Total value
Number	Thermal conductivity (W/(m·K))	Apparent density (kg/m³)	Compressive strength (MPa)	Bending strength (MPa)	d_1	d_2	d_3	d_4	$d = \sqrt[4]{d_1 d_2 d_3 d_4}$
1	0.1649	830	6.80	1.314	0.60	0.72	0.96	0.94	0.79
2	0.1338	730	4.99	0.848	0.74	0.82	0.70	0.61	0.71
3	0.1167	616	3.35	0.689	0.85	0.97	0.47	0.50	0.66
4	0.1406	751	5.24	0.898	0.71	0.80	0.74	0.65	0.72
5	0.1014	599	2.77	0.701	0.98	1.00	0.39	0.50	0.66
6	0.1621	812	6.97	1.273	0.61	0.74	0.98	0.92	0.80
7	0.0995	604	2.30	0.497	1.00	0.99	0.32	0.36	0.59
8	0.1653	799	7.08	1.391	0.60	0.75	1.00	1.00	0.82
9	0.1502	698	4.62	0.749	0.66	0.86	0.65	0.54	0.67

NEXT STEPS

1. **Further research:**
Although this idea sounds promising, still more research is required to make sure it applies to roads. Currently, it has only been used for thermal coating of mine roadway walls.
2. **Testing:**
For a start, it could be implemented and tested in sections of the Hamilton-Brantford Rail Trail or the Bruce Trail.
3. **Mass production:**
If proven effective, it could be a great revenue-generating tool and boost the economy of the city while creating jobs.

Hopefully, this material could help optimize and reduce costs as Hamilton invests $60 million toward the construction and expansion of its cycling infrastructure.[5]

REFERENCES

1. The Hamilton Spectator. (n.d.). The Hamilton Spectator. https://www.thespec.com/
2. Sisto, R. (2019). Carbon footprint estimation in road construction: La Abundancia-Florencia case study. ResearchGate. https://www.researchgate.net/publication/332492697_Carbon_Footprint_Estimation_in_Road_Construction_La_Abundancia-Florencia_Case_Study
3. https://fao-on.org/en/
4. Zhang, Y., Yin, S., Mu, H., Zhang, X., Tan, Q., & Shao, B. (2024). Study on the performance of lightweight roadway wall thermal insulation coating containing EP-GHB mixed ceramsite. *Building Simulation, 17*(3), 785–798. https://doi.org/10.1007/s12273-024-1105-x
5. City of Hamilton. (n.d.). City of Hamilton. https://www.hamilton.ca/