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A Sustainable Alternative for Road Construction with Low Carbon Footprint

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"GREENING THE GLOBE, ONE ROAD AT A TIME
the Power of Geopolymer Concrete for Roads"

WHAT IS CARBON FOOTPRINT?

- Carbon Footprint
  - Human Activities
    - Release Greenhouse Gases (GHGs), (such as methane, CO_2, etc)
    - Involves use of Energy for various purposes
  - Carbon Footprint = Embodied CO_2 Emission + Embodied Energy
  - A quantified measure of impact of our daily choices and actions on the environment

- Carbon Footprint of humans is due to :
  1. Burning fossil fuels (e.g., vehicles on road, in air, on/under water, heating homes, etc)
  2. Industrial processes (e.g., manufacturing, construction)
  3. Agricultural activities (e.g., livestock, deforestation, waste burning, etc)
  4. Waste management (filling in landfills, burning in incineration plants, etc)
  5. Food production and consumption (especially meat, dairy)
  6. Industrial products (e.g., electronics, clothing, etc

- Reducing Carbon Footprint is essential to mitigate climate change by:
  1. Using renewable energy sources
  2. Increasing energy efficiency in activities
  3. Adopting plant-based food
  4. Planning to conserve water in various ways
  5. Manage waste by 'Reducing, Reusing, Recycling'
  6. Supporting sustainable practices and policies

Traditional Portland cement based concrete

- Portland cement production
  - Involves about 1400° C
  - Embodied Energy (EE) is high
  - CO_2 emitted (due to burning of limestone)
  - CO_2 is a major greenhouse gas
  - Estimated global emission - 8% of total
- Causes depletion of natural resources
- Portland cement usage
  - Essential for infrastructure constructions

What is Geopolymer Concrete?

- Binder

- Inorganic Polymer (Not Plastic, not organic)
- Produced From
  - Industrial By-products (Fly Ash, Slag, etc,)
  - Ore Wastes

- Zero Portland Cement
- Quantified Reduced Carbon Footprint

Benefits of Geopolymer Concrete

- Lower CO_2 emissions (up to 80% reduction)
- Lower Carbon Footprint (Quantifiable)
- Utilizes waste materials (reduces landfill waste)
- Improved durability and strength
- Resistance to hazardous chemicals and heat

Fields of GPCs in Road Construction

- Pavements
- Bridges
- Highways
- Airport Taxiways and Runways
- Etc

Challenges and Limitations

- Higher upfront cost (further study can reduce)
- Identification of sources of raw materials
- Need for trained labor and equipment
- Future Directions
  - Research and development opportunities
  - Scaling up production and adoption
  - Potential for hybrid materials and applications

Conclusive Remarks

- Geopolymer concrete offers a sustainable solution for road construction (lower carbon footprint)
- Contribute to mitigation of global warming effects
- Further innovation and adoption are crucial for greener future of the MOTHER EARTH

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