Defining “Green Concrete”

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Introduction

Sustainable development was originally defined by the Brundtland Commission in their report to the United Nations in 1987 as practices which meet the needs of the present without compromising the ability of future generations to meet their own needs. Although this definition was given over 20 years ago, it still remains in wide use today due to the difficulty in defining what sustainable development really is. One objection to the term “sustainable development” is that development is, by mere definition, not sustainable, so the terms “sustainability” or “environmentally sustainable development” are used to differentiate this key point. However, the two terms are often used interchangeably.

Modern attempts at understanding sustainability often visualize it as the integration of the three “pillars”: the environment, society, and the economy. The visualization of this concept, shown in Figure 1, demonstrates the relationship between these systems. For example, since society exists within the environment, the well-being of society depends on the well-being of the environment.

Most discussion regarding sustainability focuses on the environmental aspect in general and on climate change in particular. This may be due to the urgency of the action necessary to mitigate climate change; according to the IPCC (Intergovernmental Panel for Climate Change), efforts to reduce greenhouse gas emissions in the near future can have long-term benefits for reducing the effects of climate change. The deterioration of the global environment will, by extension, have severe consequences for society and the economy due to an increase in environmental disasters.

The concrete industry follows the general trend of equating sustainability with environmental consideration, as most discussions of sustainable practice in the concrete industry center on the reduction of CO₂ emissions, resource consumption, waste and recycling, and energy usage. As a result, the term “green concrete” has become synonymous with “sustainable concrete.” However, using the term “green” — which primarily carries with it the image of environmental consideration — may neglect the importance of the other aspects of sustainability.

Focusing on “Green”

As mentioned above, environmental aspects and climate change receive the most focus when discussing sustainability in the concrete industry. This can be attributed to the huge amount of CO₂ released in the production of Portland cement, with some researchers estimating that the cement industry is responsible for roughly 7% of the world’s total CO₂ emissions. Since the cement industry is responsible for such a large environmental impact, naturally the focus will be on how to reduce that impact. Sakai proposed four CO₂ reduction scenarios: carbon capture and storage, improving cement production systems, usage of admixtures and alternative cementitious materials to reduce usage of Portland cement, and consideration of environmental impact at the structural design phase. The production and usage of Portland cement is considered to be the most important aspects for achieving sustainability, and materials which reduce CO₂ emissions may be considered “green.”

Another approach was proposed by Mehta, who suggested three elements which should form the foundation for sustainable concrete technologies: conservation of concrete-making materials, durable structures, and a holistic approach. This recommendation does not focus on CO₂ reduction specifically, but emissions reduction is achieved by reducing the usage of Portland cement through...
the application of alternative cementitious materials (high-volume fly ash in particular) and increasing the service life of infrastructure. However, it is the final point — a holistic approach — which suggests the consideration of factors other than simply reducing the environmental impact. Mehta’s proposal emphasizes that the concrete industry itself needs to consider a holistic approach in both technology and education, become more aware of its role in society, and work to provide not only a construction material but also consider the needs of society as a whole.

**Considering Society and Economy**

Some of the difficulty in considering social and economic impact is the diversity of possibilities for what, exactly, constitutes social and economic impact. The concrete industry is a massive employer world-wide, and concrete material is a fundamental component of the infrastructure necessary to support human societies. Implementation of strict environmental requirements could place strain on the concrete industry and reduce income; it could also produce more work by means of increased research, development, and investment in new technologies to satisfy those stricter requirements. Therein lies one of the questions when trying to consider the environment aspect with the other aspects: is a sustainable system which reduces the quality of life for people within that system acceptable?

One means of considering society and the economy is provided by the hierarchy shown in Figure 1. Since the society and economy exist within the bounds of the environment, improving the state of the environment should, directly or indirectly, improve the state of the other two aspects. This view can be widely seen in the focus on climate change and CO₂ emissions reduction over other aspects of sustainability — the reason being that, if environmental disaster is not prevented, it will no longer be necessary to consider the well-being of society.

Another way to evaluate the social and economic impact is by surveying those who are directly affected by changes in the concrete industry. Not only can the relevant indicators be established, but weighting or prioritization can also be determined. However, one difficulty with this approach is in the large variety of perspectives which may exist with respect to the concrete industry and its practices, and resolving conflicts in prioritization or indicators could be a difficult hurdle to overcome.

**Indicators**

Defining a material requires indicators which can be used to show the material’s performance or characteristics. For normal concrete, compressive strength and slump are two of the most commonly-used indicators to describe the concrete’s characteristics, but “green concrete” will require other indicators which consider the environmental impact. CO₂ emissions have already been shown as a widely-applied means of evaluating the environmental impact, and it can also be applied for the evaluation of concrete materials. However, to evaluate sustainability more fully, other indicators which evaluate social or economic impact should also be used. As mentioned before, if the impact on society and the economy is to be evaluated indirectly through environmental impact, then an indicator such as CO₂ may be enough to define “green concrete.” However, if indicators taken by survey from the relevant social groups are to be considered, then perhaps the term “sustainable concrete” is more appropriate to reflect the wider scope which was considered in the development of the material.

**Conclusion**

There still remains the question of whether the term “green concrete” is fully representative of sustainable concrete materials. It would seem that the difference between “green concrete” and “sustainable concrete” is similar to the difference between “environmentally sustainable development” and “sustainable development,” as was discussed in the introduction to this paper. Therefore, the means for defining whether a concrete is “green” versus “sustainable” depends upon what criteria are used to develop and evaluate that material.

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**References**