

Defining sustainability criteria for concrete production in Panama: A participatory approach with industry consultation

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Supplementary material

Form questions

Sustainable Concrete Qualification Criteria in Panama

Aim of the activity: To validate the qualification criteria for sustainable concretes, based on the responses from the expert panel «What is a sustainable concrete in Panama?» held on May 9, 2025, and a seminar-workshop for the discussion of strategies, performance indicators, regulations, public policies and implementation challenges, and how to overcome them.

Participant data

The privacy of participants' data is guaranteed. These data will not be linked to the responses.

Name of the participant (Open-ended question, text)

Email (open-ended question, text)

Organization to which the participant belongs (open-ended question, text)

Position held (closed-ended, single-choice question)

- Undergraduate student
- Graduate student
- Researcher
- Professor
- Administrative staff
- Industry representative
- Government representative
- NGO representative
- Other

Area of expertise (open-ended question, text)

Criteria validation

What are the characteristics of a sustainable concrete? in order of priority. (ranking question)

- Proves performance using quantitative data
- Considers social aspects
- Cost-benefit balance
- Incorporates local raw materials
- Maintains or improves mechanical performance, durability and quality
- Lower water consumption
- Lower energy consumption
- Lower resource consumption
- Lower greenhouse gas (GHG) emissions
- Lower waste generation

What other characteristics do you consider a sustainable concrete should have? (open-ended question, text)

Do you consider it viable to move to project specifications based on performance-based concrete design instead of cement-type-based concrete design (I, II, III, IV and V)? (closed-ended, single-choice question)



- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Do you consider it viable to include environmental criteria within the performance criteria for concrete? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Do you consider it viable to include social aspects within the performance criteria for concrete? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Raw materials

Do you consider viable the incorporation of alternative aggregates in the concrete mix with a minimum established percentage? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Rate the viability of incorporating the following alternative aggregates into concrete production (Likert-scale question)

- Recycled concrete
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know
- Crushed glass
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know
- Crushed blocks
 - Not viable
 - Not very viable
 - Viable

- Very viable
- Proven viability
- Do not know

What other alternative aggregates options do you consider viable in Panama? (open-ended question, text)

Do you consider it viable to incorporate Supplementary Cementitious Materials (SCMs) into the concrete mix with a minimum established percentage? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Rate the viability of incorporating the following Supplementary Cementitious Materials (SCMs) into concrete production. (Likert-scale question)

- Slag
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know
- Silica fume
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know
- Fly ash
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know
- Natural pozzolans
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know
- Calcined clay
 - Not viable
 - Not very viable
 - Viable

- Very viable
- Proven viability
- Do not know

- Waste from rice production
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know

- Waste from coffee production
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know

- Waste from bamboo production
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know

- Tire rubber powder
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know

- Fillers
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know

- Mixing different SCMs sources
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know

What other Supplementary Cementitious Materials (SCMs) options do you consider viable in Panama? (open-ended question, text)

Do you consider that establishing a minimum mandatory use of Supplementary Cementitious Materials (SCMs) within regulations for concrete production would negatively impact your operation? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «Yes» to the previous question, state how your operation would be impacted. (open-ended question, text)

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Do you consider it viable to partner with other producers and consumers towards the implementation of a circular economy? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Do you agree with minimizing the production and use of bagged cement? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Water

Do you consider the measurement and monitoring of water sources in concrete production plants to be viable? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Do you implement water-recycling practices in concrete production? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, do you consider the implementation of water recycling in concrete production viable? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Do you implement rainwater harvesting in concrete production? (closed-ended, single-choice question)



- Yes
- No
- Do not know

If you answered «No» to the previous question, do you consider rainwater harvesting implementation in concrete production viable? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Do you perform water quality monitoring at the concrete production plant? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «Yes» to the previous question, state in which water flows quality is monitored (select all the options that apply). (closed-ended multiple-choice question)

- IDAAN water for human consumption
- IDAAN water for concrete mixing
- Groundwater (well)
- Water for reuse
- Effluent to sewage
- Effluents to water sources or adjacent land
- Other

Rate the viability of using alternative sources of water (i.e., other than IDAAN water) in the concrete mix (Likert-scale question)

- Groundwater (well)
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know
- Rainwater
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know
- Recycled water from truck washing
 - Not viable
 - Not very viable
 - Viable
 - Very viable

- Proven viability
- Do not know

What other alternative sources of water do you consider viable for concrete production in Panama? (open-ended question, text)

Do you consider that establishing restrictions regarding the supply of water from the IDAAN in concrete production would negatively impact your operation? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «Yes» to the previous question, state how your operation would be impacted. (open-ended question, text)

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Do you think that increasing the cost of IDAAN's water supply in concrete production would negatively impact your operation? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «Yes» to the previous question, state how your operation would be impacted. (open-ended question, text)

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Energy and CO₂

Do you consider the transition to electric or hybrid vehicles and equipment viable in concrete production in Panama? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Rate the viability of using alternative energy sources in concrete production. (Likert-scale question)

- Solar
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know
- Biomass
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know

- Waste (co-processing)
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know
- Hydrogen
 - Not viable
 - Not very viable
 - Viable
 - Very viable
 - Proven viability
 - Do not know

What other alternative energy sources do you consider viable in concrete production in Panama? (open-ended question, text)

Do you consider CO₂ injection into the concrete mix viable as carbon capture? (closed-ended, single-choice question)

- Yes
- No
- Do not know

If you answered «No» to the previous question, state the reason. (open-ended question, text)

Activity evaluation

Rate this activity. (qualifying question)

- 1 star
- 2 stars
- 3 stars
- 4 stars
- 5 stars