FINAL SCRIPT: APPROVED FOR FILMING

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Title: Assessing Disaster Resilience of Concrete with Titanium Dioxide Nanoparticles

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Author Questionnaire

1. Microscopy: Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **No**

2. Software: Does the part of your protocol being filmed include step-by-step descriptions of software usage? **No**

3. Filming location: Will the filming need to take place in multiple locations? **Enter Yes or No.**

Current Protocol Length
Number of Steps: 18
Number of Shots: 33

Authors, as you have not returned the script with interview answers, I have deleted the interview part from the video script. However, your protocol remains unchanged and please proceed with the shoot as described below.

1. *Videographer: Please obtain headshots for the authors who are present at the shoot location*

Protocol

2. **Specimen Preparation and Curing**

2.1. To begin, prepare four groups of specimens using a concrete mix of Portland CPII *(C-P-eye-eye)* cement, crushed stone, medium-washed river sand, and water, maintaining a water to cement ratio of 0.5 **[1-TXT]**. For each 3.63-kilogram specimen, weigh appropriate amounts of cement, sand, gravel **[2-TXT]**, and add water **[3-TXT]**.

2.1.1. WIDE: Talent organizing four labeled trays for specimens. **TXT: Cement:Sand:Gravel = 1:2:3** *Video editor: This is a ratio*

2.1.2. Close up of adding cement, sand and crushed stone to the container. **TXT: Cement: 558.46 g; Sand: 1,116.92 g; Gravel: 1,675.38 g; Water: 279.23 g**

2.1.3. Close up of adding water in a graduated container. **TXT: Add any additive to the dry ingredients first**

2.2. Homogenize all components thoroughly to obtain the most uniform mass possible **[1]**. Cast the mixed concrete into the molds **[2]** and inspect the mixture for signs of aggregate segregation, free-water accumulation, or staining from unmixed material to ensure a uniform consistency for representative results **[3]**.

2.2.1. Talent mixing the concrete until the mass appears uniform.

2.2.2. Talent pouring the mixed concrete from the mixing container toward prepared molds.

2.2.3. Close-up of the mix surface showing no aggregate segregation, free water, or unmixed streaks.

2.3. Now, mold the test specimens in cylindrical metal forms 10 centimeters in diameter and

20 centimeters in height **[1]**. Fill each mold so the concrete reaches the designated level with uniform distribution **[2-TXT]**.

2.3.1. Talent positioning cylindrical metal molds labeled with diameter and height specifications.

2.3.2. Talent distributing the concrete evenly into the mold until it reaches the marked level without overfilling. **TXT: Avoid voids**

2.4. Produce Sample A and designate it as the negative control without any additives to serve as the baseline for comparison with the other specimens **[1]**.

2.4.1. Talent preparing and labeling Sample A while referencing the listed standards.

2.5. Produce Sample B by incorporating 1 percent Nano titanium dioxide, approximately 36.3 grams, into the concrete mix **[1]**. Distribute the nanoparticles evenly across the mass to prevent agglomeration **[2].** Similarly prepare samples C and D, ensuring homogeneity among the sample sets **[3-TXT]**.

2.5.1. Talent weighing 36.3 grams of Nano titanium dioxide.

2.5.2. Talent nano titanium dioxide to the container and thoroughly mixing to disperse nanoparticles uniformly.

2.5.3. Talent placing sample C and D beside samples A and B. **TXT: Sample C: 2% NanoTiO_2 ; Sample D: 3% NanoTiO_2**

2.6. Now, prepare Sample E by incorporating a 3 percent copper-based plasticizer additive, approximately 108.9 grams, into the concrete mix **[1]** and designate this sample as the positive control to compare the effect of the plasticizer relative to the other samples **[2]**.

2.6.1. Talent weighing 108.9 grams of the copper-based plasticizer and combining it with the mix as per the dilution step.

2.6.2. Talent labeling Sample E as “Positive control – plasticizer.”

2.7. Store all samples in an area with controlled conditions, protected from environmental influences, to await the curing time **[1]**.

2.7.1. Talent transferring labeled molds to a controlled-condition storage area and closing the chamber.

2.8. Cure the specimens in a humidity-controlled area maintained at a temperature of around 23 degrees Celsius and a relative humidity of at least 95 percent for 24 hours **[1]**. After this initial period, submerge the specimens in lime-saturated water maintained at the same temperature of 23 degrees Celsius, for continued curing over the designated period **[2]**.

2.8.1. Talent placing freshly molded specimens into a humidity-controlled chamber set to 23 degrees Celsius and 95 percent relative humidity.

2.8.2. Talent transferring cured specimens after 24 hours from the chamber into a tank filled with lime-saturated water.

2.9. After curing, remove the specimens **[1]** and measure the weight of each specimen to confirm that each has an average mass of 3.63 kilograms **[2]**.

2.9.1. Talent removing specimens from the curing tank and gently drying the surface with a cloth.

2.9.2. Talent placing a specimen on a precision balance.

2.10. Condition the specimens at room temperature of around 23 degrees Celsius, according to the following schedule **[1]**.

2.10.1. TEXT ON PLAIN BACKGROUND:

7 days: Samples A1, B1, C1, D1 and E1

14 days: Samples A2, B2, C2, D2 and E2

28 days: Samples A3, B3, C3, D3 and E3

3. Compressive Strength Testing

3.1. Subject each specimen to an axial compression test using a universal tensile and compression testing machine **[1]**.

3.1.1. Talent pointing to the universal testing machine in the laboratory and switching it on.

3.2. Ensure that the load cell capacity of the testing machine is compatible with the specimen dimensions **[1]**, and verify that a digital control system is enabled for real-time monitoring and recording of the applied load **[2]**.

3.2.1. Talent examining the load cell capacity on the machine's display.

3.2.2. Show the digital control interface displaying load readings and the active recording system.

3.3. Continue applying the compressive load until the specimen fails **[1]**, and record the maximum supported load at the moment of rupture **[2]**.

3.3.1. Talent monitoring the machine as the specimen compresses and begins to crack.

3.3.2. Talent noting in the notebook.

3.4. Compute the compressive strength of each specimen using the formula **[1]**.

3.4.1. TEXT ON PLAIN BACKGROUND:

$$fc = F\text{max} / A$$

where:

fc = compressive strength (N/mm^2),

Fmax = maximum recorded load (N)

A = test specimen cross-sectional area (mm^2). 1 N/mm^2 = 1 MPa

3.5. Then, conduct the compressive-strength test by positioning each cylindrical specimen measuring 100 millimeters in diameter and 200 millimeters in height vertically at the center of the hydraulic press **[1]**. Ensure proper contact between the specimen and the loading plates **[2-TXT]**.

3.5.1. Talent centering a cylindrical specimen on the press base and lowering the upper loading plate to touch the specimen.

3.5.2. Close-up of the contact surfaces to confirm proper seating and alignment according to standard. **TXT: Align according to ABNT NBR 5739:2018**

3.6. Apply the axial load continuously and without impact at a rate of around 0.45 megapascals per second **[1]**. Repeat this procedure for all three specimen sets: control, titanium dioxide-doped, and copper-based additive samples **[2]**.

3.6.1. Show the test rate setting adjusted to 0.45 megapascals per second.

3.6.2. Talent removing the previous sample and placing the next one.

3.7. Record all values systematically for later comparison among the different sample sets **[1]**.

3.7.1. Display a digital spreadsheet or data logger with organized results for all samples.

3.8. Finally, compare the recorded compressive strength values to assess the mechanical behavior and performance differences between the control, titanium dioxide-doped, and copper-based additive specimens **[1]**.

3.8.1. Show plotted comparison charts on a computer screen showing variations and talent pointing to the data and analysing.

Results

4. Results

4.1. Compression tests showed that concrete specimens containing 1% titanium dioxide by mass had higher compressive strength **[1]** than both the control concrete **[2]** and those with 3% copper-based plasticizer **[3]**.

4.1.1. LAB MEDIA: Figure 3. *Video editor: Highlight all the bars for B*.

4.1.2. LAB MEDIA: Figure 3. *Video editor: Highlight the bars labeled A*.

4.1.3. LAB MEDIA: Figure 3. *Video editor: Highlight the bars labeled E*.

4.2. Among samples subjected to 28 days of curing during compressive strength testing, specimens B3, C3, and D3 appeared visibly lighter in color **[1]** than specimens labeled A3 and E3 **[2]**.

4.2.1. LAB MEDIA: Figure 2. *Video editor: Highlight the specimens labeled B3, C3, and D3, showing their lighter coloration*.

4.2.2. LAB MEDIA: Figure 2. *Video editor: Highlight the specimens labeled A3 and E3, which are darker in color*.

4.3. The specimen labeled B had the highest compressive strength after 28 days of curing at 17,379 megapascals **[1]**.

4.3.1. LAB MEDIA: Table 2. *Video editor: Highlight the cell in the row labeled "B" and column labeled "28 Days" with the value 17,379*.

4.4. Specimens labeled A and E showed lower compressive strength values after 28 days of curing, with values of 13,018 and 9,725 megapascals, respectively **[1]**.

4.4.1. LAB MEDIA: Table 2. *Video editor: Highlight the cell in the row labeled "A" and column labeled "28 Days" with the value 13,018*.

4.4.2. LAB MEDIA: Table 2. *Video editor: Highlight the cell in the row labeled "E" and column labeled "28 Days" with the value 9,725*.

- **Portland cement**

Pronunciation link: https://www.collinsdictionary.com/dictionary/english/portland-cement

collinsdictionary.com+2oxfordlearnersdictionaries.com+2
IPA: /ˈpɔrt-lənd ˈsɪmɛnt/
Phonetic Spelling: port-lund si-ment

- **homogenize**

Pronunciation link: https://www.merriam-webster.com/dictionary/homogenize Merriam-Webster+2collinsdictionary.com+2
IPA: /həˈmɑː.dʒə.naɪz/
Phonetic Spelling: huh-mahr-juh-nyz

- **agglomeration**

Pronunciation link: https://dictionary.cambridge.org/pronunciation/english/agglomeration Cambridge Dictionary+1
IPA: /əˌɡlɑː.məˈreɪ.ʃən/
Phonetic Spelling: uh-glah-muh-RAY-shuhn

- **segregation**

Pronunciation link: https://dictionary.cambridge.org/pronunciation/english/segregation Cambridge Dictionary+1
IPA: /ˌsɛg.rəˈgeɪ.ʃən/
Phonetic Spelling: seg-ruh-GAY-shuhn

- **saturation**

Pronunciation link: https://dictionary.cambridge.org/us/pronunciation/english/saturation Cambridge Dictionary
IPA: /ˌsætʃ.əˈreɪ.ʃən/
Phonetic Spelling: satch-uh-RAY-shuhn