The Effectiveness of the Water Additional Ingredient Urea Co (Nh2)2 to the Concrete Fc' 20 Mpa on Curing Process

Hafiq Syaifudin¹, Rio Rahma Dhana²

¹, ²Faculty of Engineering, Lamongan Islamic University

Email: ¹hafigsyafudin@gmail.com, ²riorahma@unisla.ac.id

ABSTRACT

Concrete quality depends on the value of the ratio of materials, how to blend and how to pour the concrete mixture, how to compact and how to care for it during the hardening process. This study aims to determine how much influence the curing process using water with a mixture of Co(NH2)2 and normal water has on the compressive strength of concrete fc' 20 Mpa. The sample is a cylindrical specimen with a diameter of 15 cm and a height of 30 cm. Samples were made 3 test objects with the age of 28 days and tested coherently. The compressive strength of normal concrete has increased in quality with the age between 7 is 9.1 Mpa to 28 days is 17 Mpa. While the concrete with curing process using water with a mixture of urea increased at age 7 with a value of 10.8 Mpa to 21 days with a value of 14.4 Mpa, but at age 28 the strength of the concrete decreased by 12 Mpa. Cracks with cone and split types are 10 pieces, this can happen because the material in the concrete mixer has not been mixed well during the concrete manufacturing process.

Keywords: Treatment, Compressive Strength, Crack Pattern, Water Curing
1. Introduction

Concrete is made with materials derived from sand, gravel, cement, stone or other aggregates, which mixed together with cement paste and water to form a rock-like mass. Concrete treatment is a procedure used to maintain a stable temperature and humidity changes inside and outside the concrete. Thus the concrete must be resistant to the process of quality damage that can occur. [11]

Concrete quality depends on the value of the ratio of materials, how to mix and how to pour the concrete mixture, how to compact and how to treat during the hardening process. Concrete construction is often faced with certain problems which are usually caused by negligence in the manufacture of concrete. One of them is the appearance of cracks on the concrete surface. These cracks are usually caused by an incorrect hardening process or excessive use of cement. Generally, the heat in the concrete will expand the concrete whereas when the concrete hardens then the concrete will shrink. In concrete hardening is usually faster on the outside than on the inside. Things like this cause internal stresses in the concrete which, if they exceed the stability of the separation of the concrete, will cause cracks on the concrete surface.

So that this research is expected to provide answers regarding the effect of additional ingredient urea Co (Nh) water on the 20 MPa fc' concrete in the planned curing process. The purpose of this study was to determine how much influence the curing process using water with a mixture of urea and normal water had on the compressive strength of the concrete quality fc' 20 Mpa.

2. Research Method

The design in this research is the process of analyzing and collecting data. This research uses experimental research methods. Design planning begins with observations and literature studies that have been carried out and known, to the formation of the formulation of framework ideas. Then proceed with direct sample examination at the Comprehensive Laboratory of Civil Engineering, Lamongan Islamic University which aims to find out, get data to compare the value of the results obtained in the study with the condition of the specified plan value. The experimental specimens in this study used the ASTM and SNI standards because they were in accordance with the guidelines at the Lamongan Islamic University Laboratory.

The stages of data analysis in this study were to determine the effect of the Additional Water Ingredient Urea CO (NH₂) Against Concrete Fc' 20 Mpa In the Curing Process, broadly includes:

1. Cement Investigation
   a. Semen Normal Consistency Check
   b. Cement Hardening Inspection and Bonding Time
   Cement Density Check
2. Fine Aggregate Investigation
   a. Fine Aggregate Sieve Analysis Examination
   b. Fine Aggregate Density Check on SSD Condition
   c. Inspection of Fine Aggregate Infiltration Moisture Content
   d. Fine Aggregate Volume Weight Check
   e. Fine Aggregate Moisture Check
3. Coarse Aggregate Investigation
   a. Coarse Aggregate Sieve Analysis Examination
   b. Coarse Aggregate Density Check on SSD Condition
   c. Inspection of Coarse Aggregate Infiltration Moisture Content
   d. Coarse Aggregate Fill Weight Check
   e. Coarse Aggregate Moisture Check

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After testing the mixed concrete mixture to determine the content and levels of its characteristics, the next step is planning the production of a concrete mixture based on SNI 03-2834-2000, testing the compressive strength of concrete based on the guidelines and referring to medium quality concrete with a compressive strength of fc 20 MPa. The specific test data are as follows:

1. Making Concrete Design Mix
2. Concrete Slump Inspection
3. Cylindrical Concrete Manufacturing Process
4. Fresh Concrete Weight Volume Test
5. Curing Process (Concrete Treatment and Soaking)
6. Cylindrical Concrete Compressive Strength Testing Experiment
7. Analysis of Compressive Strength and Crack Type

Source: Personal Data Research Results, 2022

Figure 1. Research Flow Chart

The process begins with determining the formulation of the problem and continues with data collection, sample making, sample testing and analysis.
3. Results and Discussion

3.1 Analysis of Fine Aggregate Inspection

From the results of the examination of fine aggregates, the following results are obtained:

1) Based on the test, the results of the analysis of the sand filter are classified as zone II, namely the sand is quite coarse, and the results of FM (fine modulus value) or fine modulus value are 3.46%. In accordance with ASTM C 33-78, the fineness modulus of the sand filter analysis obtained from the test meets the standards set by ASTM.

2) According to the test results, the average density of fine sand aggregate is 2.78 grams. Based on ASTM C 128-78, the specific gravity of 46 sand is between 2.4 to 2.7 grams, which indicates if the test results meet the standards set by ASTM.

3) Based on the test results obtained an average of 3.34% sand infiltration water. Based on ASTM C 128-93, sand seepage water is worth between 1.47 to 4%, indicating if the test results meet the standards set by ASTM.

4) Based on the results of the volumetric test, the average mass of air contents and voids in the sand is 1649 kg/l. Based on ASTM C 29M-91, the weight of the volume of sand ranges from 1.40 to 1.90 kg/L, which indicates if the test results meet the standards set by ASTM.

5) Based on the test results, the average water content of the sand is 1.94%. Referring to ASTM C 566-89, the moisture content of sand 50 ranges from 3-5%, which indicates if the inspection and test results meet the standards set by ASTM.

| No | Examination Description | Theoretical basis | Check up result | Information |
|----|-------------------------|-------------------|-----------------|-------------|
| 1  | Filter analysis         | ASTM C 136 - 95a , the fine modulus of grain is 2.20% - 3.10% | 3.46 %         | Not Qualify |
| 2  | Fine Aggregate BJ Inspection | ASTM C 128-78, specific gravity 46 sand, between 2.4 and 2.7 grams | 2.78 grams     | Qualify     |
| 3  | Checking the moisture content of fine aggregate absorption | ASTM C 128-93, sand seepage water value between 1.47 to 4% | 3.34%          | Qualify     |
| 4  | Fine aggregate volume check | ASTM C 29M-91, sand volume weight ranges from 1.40 to 1.90 kg/L | 1649 kg/l     | Qualify     |
| 5  | Fine aggregate moisture check | ASTM C 566-89, moisture content of sand 50 ranges from 3-5% | 1.94%          | Qualify     |

Source: Islamic University of Civil Engineering Laboratory of (2022)

3.2 Coarse Aggregate Inspection Analysis

From the results of the examination of fine aggregates obtained the following results:

1) Based on the test results, FM (Fhinness modulus) or the smoothness value is 6.59%. Based on SNI 03-1968-1990, the fineness value of coarse aggregate sieve analysis does not exceed 8%, which indicates if the results of the examination of the test values meet the standards set by SNI.

2) According to the test results, the average density of crushed stone is 2.66 g/cm³. Referring to ASTM C 128-78, the specific gravity of crushed stone as coarse aggregate ranges

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between 2.4 - 2.7 g / cm³, which indicates if the results of the test meet the standards set by ASTM

3) Based on the test results, the average water absorption rate of crushed stone is 2.92 %. Referring to ASTM C 127-88-93, the coarse aggregate water infiltration is between 1 – 4%, which indicates that the result of the absorption test is in accordance with the standards determined by ASTM.

4) Based on the test results, the average volume of crushed stone content is 1.443 kg/l. Based on ASTM C 29-91, the bulk density of crushed stone is between 1.4 - 1.7 kg / l, which indicates if the aggregate volume test results meet the standards set by ASTM.

5) Based on the test results, the average water content of coarse aggregate is 1.25 %. Referring to ASTM C 566-89, coarse aggregate has a moisture content of 1-4%, which indicates if the test results meet the standards set by ASTM.

| No | Examination Description | Theoretical basis | Check up result | Information |
|----|--------------------------|-------------------|-----------------|-------------|
| 1  | Filter check             | SNI 03-1968-1990, the fineness value of coarse aggregate sieve analysis does not exceed 8% | 6.59 %         | Qualify     |
| 2  | Coarse Aggregate BJ Inspection | ASTM C 128-78, i.e. the specific gravity of crushed stone as coarse aggregate value ranges between 2.4 - 2.7 g / cm³ | 2.66 g/cm³     | Qualify     |
| 3  | Checking the Infiltration Moisture Content of Agg. Rough | ASTM C 127-88-93, namely coarse aggregate water infiltration of between 1 – 4%, | 2.92 %         | Qualify     |
| 4  | Fill Weight Check agg. Rough | ASTM C 29-91, the bulk density of crushed stone is between 1.4 - 1.7 kg/l | 1.443 kg/l     | Qualify     |
| 5  | Coarse aggregate Moisture Check | ASTM C 566-89, coarse aggregate has a moisture content of 1-4% | 1.25%           | Qualify     |

Source : Islamic University of Civil Engineering Laboratory of (2022)

3.3 Portland cement analysis

1) From the results of the cement examination, the following results were obtained: As indicated by the results of the examination, the consistency value of Portland cement was 27.2%. Regarding ASTM C 187-86, the consistency of ordinary concrete is somewhere in the range of 26% and 29%, which indicates that the experimental results meet the norms set by ASTM.

2) Based on the test, the initial setting time is 45 minutes and the final setting time is 180 minutes. Based on ASTM C 119-92, the time for Portland cement setting and hardening is from 49 minutes to no more than 375 minutes, while the test results meet the standards set by ASTM.

3) According to the test results, obtained an average density of 3.05 grams. Referring to SNI 15-7064-2004, the specific gravity of Portland cement is less than 3.00 grams, which indicates that the test results meet the standards set by SNI.
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#### 3.4 Slump Nilai Value Analysis

From the results of the examination, the slump value of the concrete mixture during the first mixture was 120 mm, and during the second mixture - 115 mm. The test results show that the results of all tests to meet the standard are included in the planned draft according to SNI 03-2834-2000, namely 60 - 180 mm.

#### 3.5 Compressive Strength Value Test Results

From the results of the research on testing the strength of concrete using normal water baths and soaking using a mixture of Co (NH2)2 as follows:

| Table 4. Concrete Test Results Using Normal Water Immersion |
|-----------------------------------------------------------|
| **Concrete Code** | **Age (days)** | **Specific Gravity (kg/m³)** | **Strong Press (MPa)** |
|-------------------|----------------|-----------------------------|---------------------|
| H1                | 7              | 2385                        | 9.6                 |
| H2                | 7              | 2366                        | 10.5                |
| H3                | 7              | 2460                        | 7.4                 |
| **Average**       |                | **2403**                    | **9.1**             |
| H4                | 14             | 2438                        | 10.5                |
| H5                | 14             | 2396                        | 11.4                |
| H6                | 14             | 2430                        | 10.7                |
| **Average**       |                | **2421**                    | **10.9**            |
| H7                | 21             | 2381                        | 11.4                |
| H8                | 21             | 2438                        | 11.6                |
| H9                | 21             | 2411                        | 12                  |
| **Average**       |                | **2410**                    | **11.6**            |
| H10               | 28             | 2408                        | 20.4                |
| H11               | 28             | 2404                        | 15.0                |
| H12               | 28             | 2415                        | 16.9                |
| **Average**       |                | **2409**                    | **17**              |

*Source: Personal Data Research Results, 2022*

It can be seen from table 4.28 that the average value of specific gravity at the age of 7 days is 2403 and the compressive strength value is 9.1 MPa, at the age of 14 days the specific gravity is 2421 and the compressive strength is 10.9 Mpa, then at the age of 21 days the specific gravity is 2410 and the compressive strength is 11.6.
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Gravity is 2410, and the compressive strength value is 11.6 MPa and at the age of 28 days the specific gravity is 2409 and the compressive strength value is 17 MPa.

**Table 5. Concrete Test Results Using Mixed Water Bathing Co (NH₂)₂**

| Concrete Code | Age (days) | Specific Gravity (kg/m³) | Strong Press (MPa) |
|---------------|------------|--------------------------|--------------------|
| H1            | 7          | 2400                     | 11.75              |
| H2            | 7          | 2426                     | 8.7                |
| H3            | 7          | 2408                     | 11.88              |
| **Average**   | **2410**   |                          | **10.8**           |
| H4            | 14         | 2438                     | 13.21              |
| H5            | 14         | 2419                     | 13.45              |
| H6            | 14         | 2426                     | 13.28              |
| **Average**   | **2427**   |                          | **13.3**           |
| H7            | 21         | 2408                     | 12.56              |
| H8            | 21         | 2415                     | 15.27              |
| H9            | 21         | 2430                     | 15.50              |
| **Average**   | **2417**   |                          | **14.4**           |
| H10           | 28         | 2411                     | 10.20              |
| H11           | 28         | 2385                     | 15.57              |
| H12           | 28         | 2374                     | 10.34              |
| **Average**   | **2390**   |                          | **12**             |

*Source: Personal Data Research Results, 2022*

Based on the values contained in table 4.29 the average value of the specific gravity of concrete using a mixture of urea at the age of 7 days is 2410 and the compressive strength value is 10.8 MPa, at the age of 14 days the specific gravity is 2427 and the compressive strength is 13.3 MPa, then at the age of 21 days the specific gravity is 2417 and the compressive strength value is 14.4 MPa and at the age of 28 days the specific gravity is 2390 and the compressive strength value is 12 MPa.

*Source: Personal Data Research Results, 2022*
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Figure 2. Graph of Compressive Strength Testing of Normal Water Cured Concrete

| Value of Compressive Strength of Mixed Water Cured Concrete Co(NH2)2 (Mpa) |
|-----------------------------|-----------------|
| 7 Day                      | 10,8            |
| 14 Day                     | 13,3            |
| 21 Day                     | 14,4            |
| 28 Day                     | 12              |

Source: Personal Data Research Results, 2022

Figure 3. Graph of Compressive Strength Testing of Cured Concrete Mixed Water Co (NH$_2$)$_2$

Based on Figures 4.26 and 4.27, it can be seen that the comparison between concrete with a quality of fc 20 Mpa in the curing process that is soaked using normal water and water with a mixture of Co (NH$_2$)$_2$, namely the compressive strength value of normal concrete has increased in quality and quality over time. The increase in age between 7 is 9.1 Mpa to 28 days is worth 17 Mpa. Meanwhile, concrete with curing/soaking process using water with a mixture of urea increased at age 7 with a value of 10.8 Mpa to 21 days with a value of 14.4 Mpa, but at age 28 the strength of concrete decreased at 12 Mpa.

3.6 Crack Type Analysis

The pattern of concrete cracks according to ASTM C39 and SNI 1974:2011 is divided into 5 types, namely:

1) cone crack pattern is a common type, because the loading of the test object is evenly distributed.

2) The pattern of cone and split cracks (cone and split), these cracks occur in homogeneous test specimens / coarse aggregate mixture during manufacture so that the loading is uneven.

3) Cone and shear crack pattern, this type of crack occurs in unbonded capping specimens / specimens that do not fit on the test surface of the machine.

4) Shear crack pattern, this crack identifies that the load given by the compression test machine is uneven. If many test results are like this, it is necessary to re-calibrate the machine.

5) columnar crack pattern can occur due to uneven loading due to the compression test equipment and the uneven surface cross-section caused by other materials.
Table 6. Analysis of Concrete Crack Type Pattern after Compressive Strength Test

| Concrete Code | Crack Type   | Concrete Code | Crack Type         |
|---------------|--------------|---------------|--------------------|
| H1            | shear        | H13           | cone and split     |
| H2            | cone         | H14           | cone and split     |
| H3            | columnar     | H15           | cone               |
| H4            | cone and split | H16          | cone and split     |
| H5            | cone and split | H17          | cone               |
| H6            | cone and split | H18          | cone               |
| H7            | shear        | H19           | cone               |
| H8            | columnar     | H20           | cone and split     |
| H9            | cone and split | H21          | columnar           |
| H10           | cone and shear | H22         | columnar           |
| H11           | cone         | H23           | cone and split     |
| H12           | cone         | H24           | shear              |

Source: Personal Data Research Results, 2022

Table 7. Number of Grouping Types of Concrete Cracks

| Description          | Amount |
|----------------------|--------|
| Cone                 | 7      |
| Cone And Shear       | 1      |
| Shear                | 2      |
| Cone And Split       | 10     |
| Columnar             | 4      |
| **Total**            | **24** |

Source: Personal Data Research Results, 2022

Based on Tables 6 and 7, after being analyzed there are 7 cone and shear crack patterns, 1 cone and shear crack pattern, 2 shear crack patterns, 2 columnar crack patterns. 4 test specimens and crack patterns with cone and split types, 10 pieces and the most, it is very likely that during the mixing process in the concrete making process, the material in the concrete mixer has not been mixed well or mixed evenly.
Based on Figure 4.29, there is the highest value between normal concrete and urea curing concrete, in the cone and split crack pattern, due to not mixing the coarse aggregate mixture perfectly, it causes the distribution of strength in the sample specimens to be uneven so that the concrete cracks follow the weakening point in the sample. in a cylindrical concrete specimen.

4. Conclusion

From the results of the data obtained in a study entitled The Effect of Additional Water Ingredient Urea Co(NH$_2$)$_2$ Against Concrete Fc 20 Mpa In Curing Process, it can be concluded that:

1) The results of the examination of the compressive strength of concrete using normal water baths, the average value of specific gravity at the age of 7 days is 2403 kg/m$^3$ and the compressive strength value is 9.1 MPa, at the age of 14 days the specific gravity is 2421 kg/m$^3$ and the compressive strength is 10.9 MPa, then at the age of 21 days the specific gravity is 2410 kg/m and the compressive strength value is 11.6 MPa and at the age of 28 days the specific gravity is 2409 kg/m and the compressive strength value is 17 MPa. The compressive strength value of normal water-immersed concrete has increased in quality and its quality with increasing age between 7 is 9.1 Mpa to 28 days, it is 17 Mpa. While the results of the examination of the compressive strength of concrete using a mixture of Co(NH$_2$)$_2$ water bath, the average value of the specific gravity of concrete at the age of 7 days is 2410 kg/m$^3$ and the compressive strength value is 10.8 MPa, at the age of 14 days the specific gravity is worth 2427 kg/m and compressive strength of 13.3 MPa, then at the age of 21 days the specific gravity was 2417 kg/m and the compressive strength value was 14.4 MPa and at the age of 28 days the specific gravity was 2390 kg/m and the compressive strength value was 12 MPa. The value of the compressive strength of concrete with the curing/soaking process using water with a mixture of urea increased at the age of 7 with a value of 10.8 Mpa to 21 days with a value of 14.4 Mpa, but at the age of 28 the strength of the concrete decreased at 12 Mpa.

2) From the results of the analysis, there are 7 cone and shear crack patterns, 1 cone and shear crack pattern, 2 shear crack patterns, 4 columnar crack patterns and 4 test specimens. crack pattern with cone and split type 10 pieces. There is the highest value between normal concrete and urea curing concrete, in the cone and split crack pattern, because the coarse aggregate mixture is not completely mixed, it causes an uneven distribution of strength in the sample specimen so that the concrete cracks follow the weakening point in the concrete specimen.

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