

Article

Influence of Curing Conditions on the Strength Properties of Polysulfide Polymer Concrete

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Abstract: In this study, the effects of curing temperature and curing time on the mechanical properties of polysulfide polymer concrete were investigated. For this purpose, several laboratory tests were conducted to measure the compressive, flexural, and bond strengths of the concrete. The ranges of curing temperature and curing time considered were -10 – 60 °C and 3–672 h (28 days), respectively. The test results show that a curing temperature above 20 °C adversely affects the strength of the concrete. Regression equations derived from the test results demonstrate the reliability of the results for the estimation of flexural and bond strengths from a given value of compressive strength.

Keywords: curing temperature; curing time; polysulfide polymer concrete; concrete strength

1. Introduction

One of the most important properties required of materials used in the civil and construction industries is durability [1]. Durability is defined as the ability of a material to endure environmental loads without deformation of form or alteration of characteristics. Because of the high early durability of polymer concrete—which is a result of its fast curing properties—as well as its high strength and chemical resistance, it is used in a wide variety of industries beyond just the construction industry [2–4].

The polysulfide epoxy resin-based concrete used in this study (hereinafter referred to as “polysulfide polymer concrete”) has a high strength and good resistance to wear, sliding, and UV rays [5–8]. It is frequently used for restoring bridge decks, constructing floors, and paving roads; in such overlay applications, this material is useful because it prevents the permeation of moisture, chlorides, and corrosive materials through the overlays [9,10]. Furthermore, the wide surface areas of the aggregates used in polymer concrete result in an increase in sliding friction, which, in turn, enhances the safety of vehicles and their passengers when it is used as a pavement [11,12]. Polysulfide polymer concrete is also known to exhibit high resistance to oxidation, a property to which its stability under long-term exposure to UV rays and resistance to unexpected (premature) material failure is attributed [13–15].

As with any other chemical reaction, the processes determining the mechanical properties of polymer concrete systems are dependent on temperature [16,17]. When such systems are heated to high temperatures, the reaction elements do not have time to mix properly and the reaction occurs too rapidly to be of any practical use. Conversely, at low temperatures, the reaction occurs too gradually, which also inhibits proper curing of the systems. Therefore, the temperatures to which polymer concrete systems are exposed during the curing process are the key factors governing their behaviors and lifespans [18].

Newly laid polymer concrete is exposed to various outdoor conditions during its curing period, depending on the season and environmental conditions [19–21]. During all seasons except winter, the temperature on the surface of a material may fluctuate between values below the freezing temperature up to 80 °C, depending on the location, extent of exposure to direct sunlight, and color of the material.

A major drawback of polymeric materials is that they are extremely sensitive to curing temperature [22]. In other words, the mechanical properties of polymers can change considerably depending on the temperature in which they are cured. If the temperature of polymer concrete during curing is within the range of its glass transition temperature, its mechanical properties will be more strongly influenced by the applied temperature [23]. Thus, it can be expected that polysulfide polymer concrete, which is a type of polymer concrete, would have a high sensitivity to curing temperature. Extensive research has been conducted to determine the effects of curing conditions on the material properties of other types of polymer concrete [24–28]; however, few studies have investigated the effects of curing conditions on the mechanical properties of polysulfide polymer concrete.

In the present study, a polysulfide polymer concrete composed of a bisphenol A-type epoxy resin and polysulfide liquid polymer as binders and an amine hardener as a curing agent was developed and tested. The effects of curing temperature and curing time on the mechanical properties of the polysulfide polymer concrete specimens, measured as the compressive, flexural, and bond strengths, were then examined. The ranges of curing temperature and curing time considered were -10 – 60 °C and 3–672 h (28 days), respectively. The results of this study are expected to be applicable to the use of polysulfide polymer concretes in the repair and paving of existing infrastructure, such as bridges and buildings.

2. Materials and Methods

2.1. Materials

Polysulfide polymer concrete typically consists of binders, a hardener, an aggregate, and a filler. The binder used in this study was a mixture of a bisphenol A-type epoxy resin YD-128 (Kukdo Chemical, Seoul, Korea) and polysulfide liquid polymer LP-3 (SPI-Chem, Philadelphia, PA, USA) in a suitable ratio resulting in a short curing time, low drying shrinkage, and superior bond strength [13]. Information on the physical properties of the epoxy resin and polymer provided by the manufacturers is shown in Tables 1 and 2, respectively.

Table 1. Physical properties of the bisphenol A-type epoxy resin YD-128.

Epoxy Equivalent Weight	Viscosity	Hydrolyzable Chlorine Content	Specific Gravity
(g/eq)	(25 °C, mPa·s)	(%, max)	(20 °C)
184–190	11,500–13,500	0.05	1.17

Table 2. Physical properties of the polysulfide liquid polymer LP-3.

Molecular Weight	Viscosity	Moisture	Specific Gravity	Mercaptan Content
(g/mol)	(25 °C, mPa·s)	(%, max)	(20 °C)	(%)
1000	940–1440	0.1	1.29	5.9–7.7

Jeffamine D-230, an amine hardener manufactured by Huntsman International LLC (Salt Lake City, UT, USA), was used as the hardener. Table 3 presents the physical properties of the hardener used in the study.

Table 3. Physical properties of the hardener Jeffamine D-230.

Molecular Weight	Viscosity	Specific Gravity	Density
(g/mol)	(25 °C, mPa·s)	(20 °C)	(20 °C, kg/m ³)
230	9	0.948	946.7

As the polymer binder is hydrophobic, it is susceptible to phase separation in water. Thus, if the aggregate contains any water, the binder will absorb it, and the bond strength between the binder and the aggregate will weaken, resulting in a reduction in the strength of the polymer concrete. Therefore, it is important to maintain the water content of the aggregate at or below 0.1% before mixing [29]. For polysulfide polymer concrete, the strength of the aggregate is important because it makes the most significant contribution to the total strength of the polymer concrete.

The aggregate used in this study was silica sand with a mean diameter of 0.35–0.7 mm and containing SiO₂ (ASS No. 5, Joomoonjin Silica Sand Co., Gangneung, Korea). To ensure superior workability, the silica sand was crushed into powder (No. 230 (63 µ)) and used as a filler. In a previous study [30], this aggregate and filler were used to produce cement concrete with a compressive strength of 300 MPa. Table 4 presents the physical properties of the silica sand, and Table 5 presents the chemical composition of the silica powder.

Table 4. Physical properties of the silica sand.

Size	Specific Gravity	Unit Weight	Absorption	Solid Volume	Finesse Modulus	Water Content
(mm)	(20 °C)	(kg/m ³)	(%)	(%)	(%)	(%)
0.35–0.7	2.64	1670	1.56	64.9	2.65	<0.1

Table 5. Chemical composition of the silica powder.

SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Other
(%)	(%)	(%)	(%)	(%)	(%)
83.22	10.00	2.21	0.39	0.19	3.99

2.2. Mixing Proportion

The optimal mix for polymer concrete can be determined by maximizing the amounts of the aggregate and filler and minimizing the amount of binder to arrive at a final mixing ratio, dictated by the workability and strengths required at the site where the polymer concrete will be used. In the present study, the binder composition ratio and concrete mixture proportion were set based on the results of tests conducted in a previous study [14]. Table 6 presents the determined values of the binder formation ratio and the mixing ratio of polysulfide polymer concrete.

Table 6. Binder formation ratio and mixing ratio of polysulfide polymer concrete.

Binder Content	Binder Formation (wt. %)			Filler	Aggregate
(wt. %)	Bisphenol A-epoxy resin	Polysulfide liquid polymer	Hardener	(wt. %)	(wt. %)
28.6	13.98	9.32	5.3	21.4	50

2.3. Strength Test Methods

The mixing ratio given in Table 6 was used to prepare polysulfide polymer concrete specimens whose compressive, flexural, and bond strengths were determined at curing temperatures of −10 °C, 5 °C, 20 °C, 40 °C, and 60 °C. These curing temperatures were established in a broad range based on the 30-year average measurements (30 °C and −4 °C) of the hottest and coldest months in Korea, considering the limits of the curing temperature to which polysulfide polymer concrete can be subjected. It was expected that this range would enable the evaluation of the dependence of polysulfide polymer concrete on curing temperature, and help to most effectively establish the proper curing temperature.

In addition to different curing temperatures, the specimens cured at 20 °C were also subjected to compressive and flexural strength tests at different curing times of 3 h, 6 h, 24 h, 168 h, 336 h, and 672 h. For the compressive strength tests, a cubic specimen (50 mm × 50 mm × 50 mm) was used, and for the flexural strength tests, a prismatic specimen (25 mm × 25 mm × 300 mm) was used. The compressive

and flexural strength tests were conducted according to ASTM C579-01 [31] and ASTM C580-02 [32], respectively. All of the other specimens, regardless of the curing temperature, were tested at a curing time of 168 h (7 days).

To assess the displacement conformability of the polysulfide polymer concrete, the load–displacement relationships were measured at the above-mentioned curing temperatures. The displacement tests used the 3-point loading condition, which was the same condition used for the flexural strength tests. The only difference was that in the displacement tests, a linear variable differential transformer, an electromechanical transducer used to measure various types of displacements, was installed at the center of each specimen to measure the displacement of the specimen caused by the applied load. For the strength and displacement tests, a universal testing machine with a maximum load of 300 kN (UT-200, MTDI Inc., Deajeon, Korea) was used. Figures 1 and 2 show images of the setups for the compressive and flexural strength tests, respectively.



Figure 1. Setup for compressive strength tests.



Figure 2. Setup for flexural strength tests.

One of the key factors affecting the performance of polymer concrete is its ability to bond to substrates. In this study, a steel plate with a yield strength of 400 MPa was used as the substrate material. On this steel plate, cylindrical specimens of polymer concrete (50 mm in diameter and 30 mm in height) were placed and cured for 7 days. For the bond strength tests, a pull-off tester (Dyna Z16, Proceq S.A., Schwerzenbach, Switzerland) was employed and the samples were tested according to ASTM C1583 [33]. A photograph of the setup for the bond strength tests is shown in Figure 3.

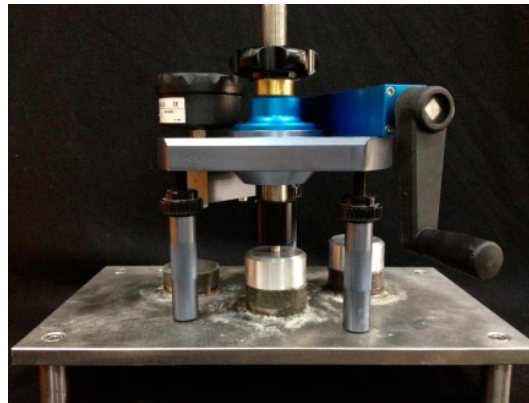


Figure 3. Setup for bond strength tests.

3. Results

3.1. General

Each strength test was conducted on several specimens to obtain the compressive, flexural, and bond strengths under the various curing conditions. The test results were analyzed to determine the change in the strength depending on the test variables. Table 7 presents the test results, which show that the curing temperature and curing time significantly affect the strength of polysulfide polymer concrete. In particular, the results show that the concrete's strength decreases with an increase in temperature, particularly at high curing temperatures.

Table 7. Results of strength tests.

Strength	Curing		Specimen						Ave.		C.V.
			No. 1		No. 2		No. 3				
			MPa	ksi	MPa	ksi	MPa	ksi	MPa	ksi	%
Comp.	Time (h)	3	9.41	1.36	9.80	1.42	9.64	1.40	9.62	1.39	2.0
		6	13.88	2.01	14.03	2.04	14.27	2.07	14.06	2.04	1.4
		24	37.91	5.50	36.22	5.25	33.87	4.91	36.00	5.22	5.6
		168	44.85	6.50	36.30	5.26	42.96	6.23	41.37	6.00	10.9
		336	45.63	6.62	54.72	7.94	45.63	6.62	48.66	7.06	10.8
		672	49.63	7.20	51.12	7.41	53.47	7.76	51.41	7.46	3.8
	Temp. (°C)	−10	58.33	8.46	55.90	8.11	54.96	7.97	56.40	8.18	3.1
		5	49.20	7.14	49.78	7.22	49.90	7.24	49.63	7.20	0.8
		20	44.85	6.50	36.30	5.26	42.96	6.23	41.37	6.00	10.9
		40	33.95	4.92	27.91	4.05	30.65	4.45	30.84	4.47	9.8
		60	13.25	1.92	19.44	2.82	15.52	2.25	16.07	2.33	19.5
Flex.	Temp. (°C)	−10	27.34	3.96	27.58	4.00	27.44	3.98	27.45	3.98	0.44
		5	26.29	3.81	25.89	3.76	25.47	3.69	25.88	3.75	1.58
		20	23.24	3.37	22.03	3.20	24.98	3.62	23.42	3.40	6.33
		40	12.83	1.86	13.54	1.96	12.59	1.83	12.99	1.88	3.80
		60	6.33	0.92	6.07	0.88	6.12	0.89	6.17	0.90	2.23
Bond	Temp. (°C)	−10	5.85	0.85	4.50	0.65	7.82	1.13	6.06	0.88	27.57
		5	6.94	1.01	9.05	1.31	6.01	0.87	7.33	1.06	21.24
		20	3.93	0.57	4.84	0.70	4.40	0.64	4.39	0.64	10.37
		40	3.54	0.51	5.22	0.76	4.24	0.61	4.33	0.63	19.47
		60	1.80	0.26	1.94	0.28	1.71	0.25	1.82	0.26	6.38

C.V., coefficient of variation.

3.2. Compressive Strength

Figure 4 shows the values for the average compressive strength of the polysulfide polymer concrete specimens at various curing times. From the figure, it can be seen that the compressive strength of polysulfide polymer concrete increases continuously with curing time. In particular, the compressive strength increases drastically within the first 24 h, beyond which it continues to increase gradually.

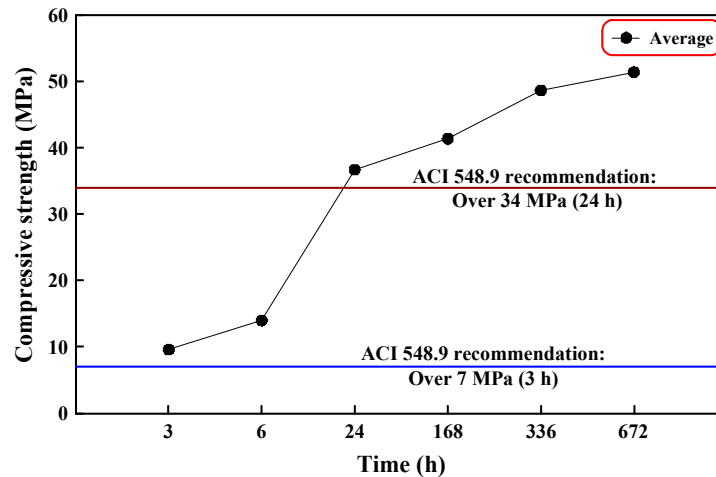


Figure 4. Effect of curing time on average compressive strength.

To analyze the strength development characteristics of polysulfide polymer concrete in detail, the rates of development of compressive strength were evaluated based on the compressive strength at 672 h (i.e., 28 days, which is considered the standard time for complete development of the compressive strength of cement concrete). The evaluation results showed that approximately 27% of the compressive strength of polysulfide polymer concrete at 672 h is developed after 6 h of hardening. In contrast, approximately 70% and 80% of the compressive strengths at 672 h are developed after 24 h (1 day) and 168 h (7 days), respectively. These results indicate a more rapid development of strength than that exhibited by cement concrete, in which 20% and 80% of its compressive strength develops after 24 h (1 day) and 336 h (14 days), respectively [34].

Rapid hardening of materials used in the construction of bridges and buildings can allow structural members to resist the large stresses induced by traffic and work operations after a shorter interval of time. Because of the short hardening time of polysulfide polymer concrete, it can be applied to structural members at nighttime and the members can be strong enough to handle traffic flow the next day. Note that, as shown in Figure 4, the compressive strength of the polysulfide polymer concrete used in this study complies with the value, over 34 MPa within 24 h and over 7 MPa within 3 h, recommended in the ACI 548.9 guideline [35].

Figure 5 shows the development of the compressive strength of polysulfide polymer concrete at various curing temperatures. This figure illustrates that the compressive strength of the concrete is strongly dependent on the curing temperature. The lower the curing temperature, the higher the compressive strength, and vice versa. Such a correlation between the curing temperature and compressive strength is not observed for cement concrete, in which the compressive strength decreases with either increasing or decreasing curing temperature from an optimum temperature somewhere in between extremes [29].

Notably, curing cement concrete at temperatures below $-4\text{ }^{\circ}\text{C}$ or above $25\text{ }^{\circ}\text{C}$ is absolutely prohibited in concrete buildings [36] because outside of this temperature envelope the development of compressive strength is either too slow or too fast; as a result, the final strength is considerably lower than the design strength. However, in the case of the polysulfide polymer concrete used in this

study, the specimen cured at $-10\text{ }^{\circ}\text{C}$ exhibited the highest compressive strength of all of the specimens cured at various temperatures. This phenomenon can be theorized to be caused by the rate of chemical reaction of the polymer concrete. The chemical reaction of polymer concrete progresses slowly in the beginning stages of curing, but continues more rapidly in the later stages, so it was found to have the maximum final strength at a sub-zero curing temperature. This behavior has been confirmed in previous research by others as well [37]. The behavior of the polysulfide concrete used in this study confirms the above fact that even below the freezing temperature, continuous chemical reactions occur in polymer concrete, leading to the development of compressive strength.

Interestingly, a higher curing temperature has a positive effect on the initial strength of polymer concrete by increasing the rate of the chemical reactions, but it has a negative effect on the final strength. In particular, the specimens cured at temperatures over $40\text{ }^{\circ}\text{C}$ had a compressive strength lower than 34 MPa within 24 h (as shown in Figure 5), which is the minimum compressive strength recommended in the ACI 548.9 guideline [35]. As a result, curing temperatures higher than $40\text{ }^{\circ}\text{C}$ can be considered to have an overall adverse effect on the compressive strength of polysulfide polymer concrete.

It should be noted, however, that this relationship between compressive strength and curing temperature is derived from a very limited set of specimens.

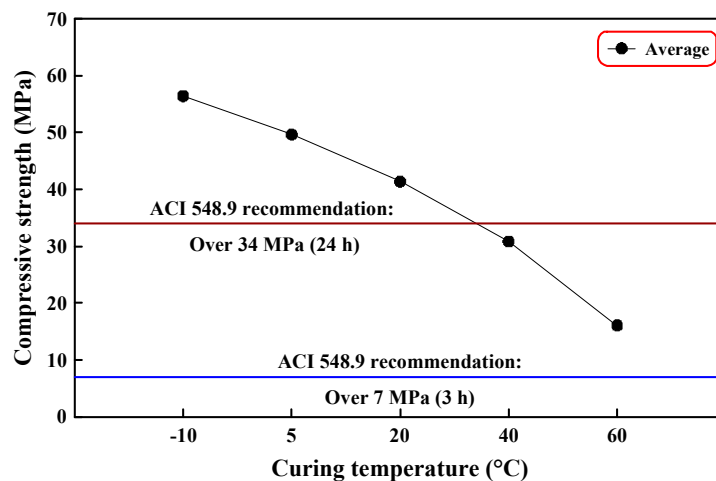


Figure 5. Effect of curing temperature on average compressive strength.

3.3. Flexural Strength

Figure 6 shows that the development of the flexural strength of polysulfide polymer concrete is also dependent on the curing temperature, as seen in the case of compressive strength. However, the development of flexural strength was found to follow a different pattern than that of compressive strength. Specifically, while compressive strength decreased steadily with an increase in curing temperature, flexural strength decreased gradually up to $20\text{ }^{\circ}\text{C}$ and then decreased rapidly above $20\text{ }^{\circ}\text{C}$. These results imply that there exists a specific temperature range in which the development of flexural strength occurs. Furthermore, in the case of the polysulfide polymer concrete used in this study, the flexural strength of the specimen cured at $-10\text{ }^{\circ}\text{C}$ was the highest among all of the specimens cured at various temperatures. This is similar to the result obtained for the compressive strength; that is, the sub-zero temperature had a negative effect on the initial flexural strength by decreasing the rate of the chemical reactions, but ultimately had a positive effect on the final flexural strength.

Within 7 days, the specimens cured at temperatures higher than $40\text{ }^{\circ}\text{C}$ exhibited a flexural strength lower than 14 MPa (as shown in Figure 6), which is the minimum flexural strength recommended in the ACI 548.5 guideline [38]. The reason for this low strength can be inferred as follows: at a curing temperature higher than $40\text{ }^{\circ}\text{C}$, chemical reaction progresses very quickly at first and not only forms chemical products with a poorer physical structure, but this rapid progress then delays subsequent

chemical reaction. As a result, the polymer concrete becomes porous, riddled with many small holes, and its compressive and flexural strengths decrease significantly. Therefore, if polysulfide polymer concrete that has been cured at temperatures higher than 40 °C is used in existing or new buildings, its low flexural strength may cause problems.

Figure 7 shows the load–displacement relationships of all of the specimens subjected to flexural strength tests at various curing temperatures. The beams cured at −10 °C and 5 °C exhibited a linear load–displacement relationship; after the maximum load was applied, these beams underwent brittle fractures, similar to the type of behavior observed in over-reinforced concrete beams.

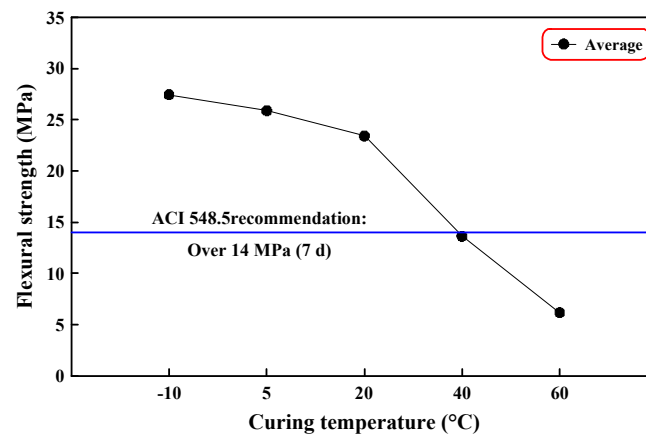


Figure 6. Effect of curing temperature on average flexural strength.

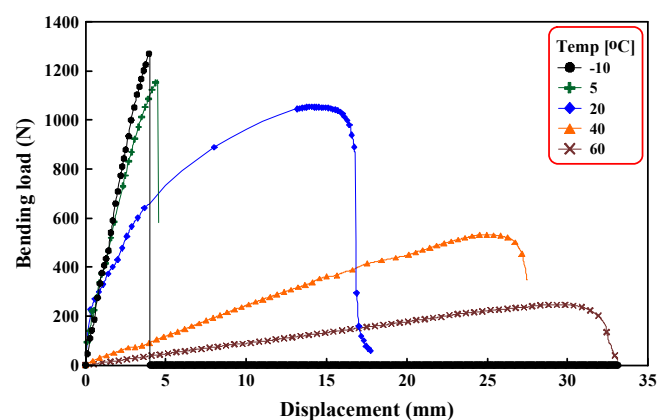


Figure 7. Load–displacement curves of beams tested for flexural strength.

In contrast, the specimens cured at 20 °C, 40 °C, and 60 °C exhibited ductile behavior, similar to the behavior of under-reinforced concrete. As a result, the specimens cured at a higher temperature showed a significantly larger displacement than those cured at a lower temperature under the same load. Therefore, the use of a higher curing temperature (above 20 °C) is recommended for improving the ductility of polysulfide polymer concrete.

3.4. Bond Strength

Figure 8 shows the bond strength between polysulfide polymer concrete and steel for various curing temperatures. The data in this figure reveal that the development of bond strength depends on the curing temperature, as is the case with the compressive and flexural strengths. However, while the compressive and flexural strengths showed the highest values at the lowest curing temperature (−10 °C), the bond strength showed the highest value at a curing temperature of 5 °C, indicating that

a curing temperature below the freezing temperature has an adverse effect on the development of bond strength.

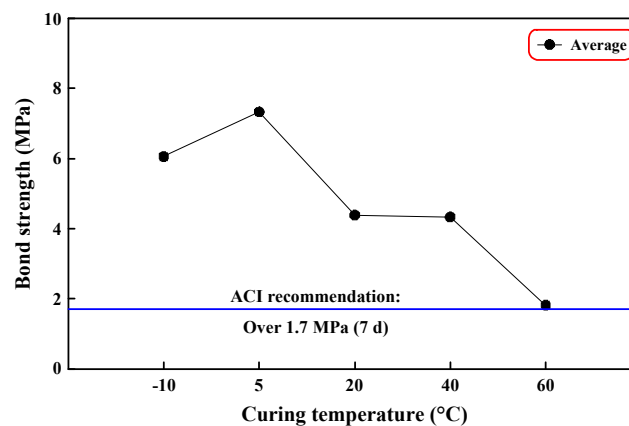


Figure 8. Effect of curing temperature on average bond strength.

Further, as in the case of flexural strength, the bond strengths for the curing temperature range of 20–40 °C were observed to decrease rapidly as curing temperatures increased above 20 °C. Additionally, as was the case with the other two strengths, the bond strength showed the lowest value for a curing temperature of 60 °C. This result was likely because of the dependence of the bond strength on the bond performance at the interface between concrete and steel. At curing temperatures higher than 20 °C, the bonding performance of the polysulfide polymer concrete to steel is negatively affected. However, the results in Figure 8 show that within 7 days of curing, all of the bond strengths achieved values greater than 1.7 MPa, which is the recommended minimum value in the ACI 548.9 guideline [35].

4. Discussion

4.1. Strength Increase Rate

Figure 9 shows the effect of various curing temperatures (−10, 5, 40, and 60 °C) on the rate of strength increase for polysulfide polymer concrete. Here, the rate of strength increase is defined as the ratio of the strength increase to the standard value of strength at 20 °C. The strength at 20 °C was selected because the average of temperatures in all seasons except winter, in which fewer construction projects are undertaken in Korea, is 19.3 °C, and because most standard test methods specify 20 °C as the standard curing temperature.

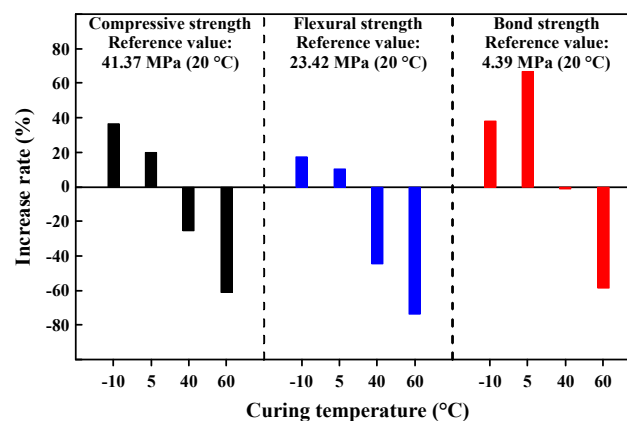


Figure 9. Comparison of rates of increase in compressive, flexural, and bond strengths as a function of curing temperature.

The results plotted in Figure 9 show that the rates of increase in the compressive, flexural, and bond strengths become higher with a decrease in the curing temperature, and vice versa. This tendency can be attributed to the strong dependence of these strengths on the curing temperature. The maximum rate of increase in the compressive and flexural strengths was found to occur at $-10\text{ }^{\circ}\text{C}$, and that in the bond strength was found to occur at $5\text{ }^{\circ}\text{C}$. The maximum rates for the compressive strength, flexural strength, and bond strength were 36.3%, 17.2%, and 67.0%, respectively. Conversely, the maximum rates of decrease for the compressive strength, flexural strength, and bond strength were all observed at $60\text{ }^{\circ}\text{C}$, with values of -61.2% , -73.7% , and -58.5% , respectively. These results suggest that it would be impossible to improve the strength of polysulfide polymer concrete by employing a curing temperature higher than $20\text{ }^{\circ}\text{C}$.

4.2. Relationship among Strengths

To assess the flexural and bond strengths with respect to the measured value of the compressive strength, the relationships between compressive strength and flexural strength and between compressive strength and bond strength were determined by a regression analysis. These relationships are shown in Figures 10 and 11, respectively. These figures yield a correlation coefficient between compressive strength and flexural strength of 0.983, and a correlation between compressive strength and bond strength of 0.940. This implies that these results are statistically significant, and that once the compressive strength of a polysulfide polymer concrete is determined, the flexural and bond strengths can be estimated with reasonable accuracy by using the regression equations.

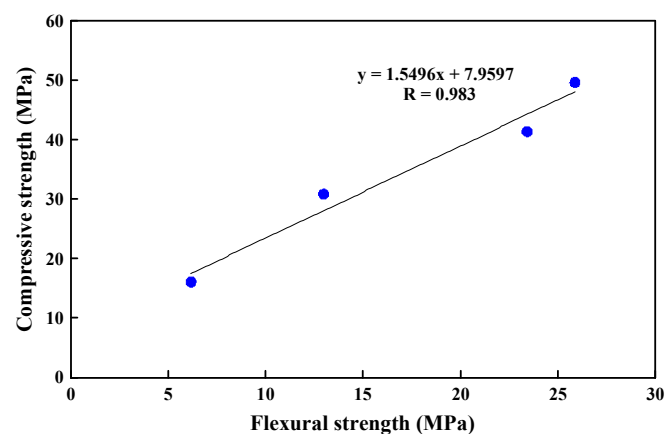


Figure 10. Relationship between compressive and flexural strengths.

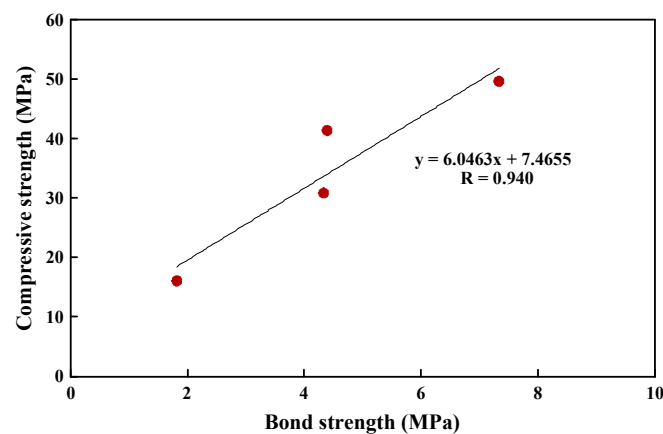


Figure 11. Relationship between compressive and bond strengths.

4.3. Strength Ratios

To determine the relationship between the compressive, flexural, and bond strengths, the corresponding strength ratios were assessed at various curing temperatures. The results are presented in Table 8, showing that the average ratio of the flexural strength to the compressive strength is 0.476, the average ratio of the bond strength to the compressive strength is 0.123, and the average ratio of the bond strength to the flexural strength is 0.264.

Table 8. Summary of strength ratios of polysulfide polymer concrete.

Curing Temperature (°C)	Strength Ratio		
	Flexural/Compressive (-)	Bond/Compressive (-)	Flexural/Bond (-)
−10	0.487	0.107	0.221
5	0.521	0.148	0.283
20	0.566	0.106	0.187
40	0.421	0.140	0.334
60	0.384	0.113	0.295
Average	0.476	0.123	0.264

Next, the ratio of the flexural strengths to the acquired compressive strengths was compared with the corresponding ratios for acrylic polymer concrete and cement concrete. For acrylic polymer concrete, the average ratio of flexural strength to compressive strengths in the range of 80–112 MPa was 0.226; for cement concrete, the ratios of flexural strength to compressive strengths of 19.6 MPa and 58.8 MPa were 0.163 and 0.113, respectively. In this study, we found that the average ratio of flexural strength to compressive strengths in the range of 16.07–56.4 MPa was 0.476, regardless of the curing temperature.

From these results, it can be concluded that the ratio of the flexural strength to the compressive strength of polysulfide polymer concrete is much higher than that of cement concrete or acrylic polymer concrete. Furthermore, the strength development properties of polysulfide polymer concrete are important because they aid in improving its toughness, and hence prevent the occurrence of brittle fracture in the structure. Additionally, these strength ratios are generally not affected by the curing temperature.

5. Conclusions

This study investigated the effects of curing temperature and curing time on the compressive, flexural, and bond strengths of polysulfide polymer concrete through a series of laboratory tests. The following conclusions were drawn from the results of this study:

- (1) In the polysulfide polymer concrete used for this study, approximately 27% of the compressive strength at 672 h (28 days) developed after approximately 6 h of curing, and approximately 80% of the compressive strength developed within 168 h (7 days). These development times are considerably shorter than those for cement concrete. Furthermore, the greater the curing temperature, the more consistently low the compressive strength. In particular, some specimens could not achieve the minimum compressive strength value of 34 MPa recommended in the ACI 548.9 guideline, despite their longer curing times. It was also found that curing temperatures above 40 °C have an adverse effect on the compressive strength of polysulfide polymer concrete.
- (2) The development of flexural strength depended significantly on the curing temperature. The flexural strength decreased gradually up to a curing temperature of 20 °C and then decreased rapidly above this temperature. The specimens cured at temperatures above 40 °C showed a flexural strength value lower than 14 MPa, which is the minimum value recommended in the ACI 548.5 guideline.

- (3) Tests for assessing the bond strength between polysulfide polymer concrete and steel showed an average bond strength of 4.8 MPa, and the bond strengths for all the curing temperatures considered in this test were higher than 1.7 MPa, which is the minimum value recommended in the ACI 548.9 guideline.
- (4) Regression analyses of the relationships between the flexural and compressive strengths and between the bond and compressive strengths revealed very large correlation coefficients of 0.983 and 0.940, respectively. These values indicate that the regression equations derived from the results can be effectively used to estimate the flexural and bond strengths from a known value of compressive strength.
- (5) In this study, the effects of curing temperature and curing time on polysulfide polymer concrete were assessed. However, these results hold true only under laboratory conditions. Accordingly, additional laboratory tests and on-site tests need to be conducted in the future in order to draw more generalized conclusions regarding the properties of polysulfide polymer concrete.

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