Study Comparative of Corrosion Rate Scrap Aluminium in Chloride Acid (HCl) and Natrium Chloride (NaCl) Solutions

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Abstract. Scrap aluminium is waste aluminium, the result of recycling that can be used as an alternative raw material with consideration of cheap and affordable prices. The use of aluminium scrap has been widely used both on a large scale such as the automotive industry, ships, aircraft, construction, etc., as well as on a small scale such as household appliances. Chloride acid is used in the process of purifying salt, cleaning porcelain, and as a stain remover on kitchen utensils, and sodium chloride, known as salt, is very corrosive due to the presence of chloride ions. The corrosive nature of chloride ions can be influenced by the concentration and duration of immersion, so it is necessary to research changes in the corrosion rate caused by the concentration and time of immersion. This study uses a method of immersion with weight loss where the specimen is immersed in HCl and NaCl with a concentration of 0.1%; 0.3%; and 0.5% with an immersion time of 5 days, 10 days and 15 days. The results showed that the highest corrosion rate of HCl occurred at 15 days immersion with a concentration of 0.1% at 1542.314 Mpy, and the smallest corrosion rate at 5 days with a concentration of 0.5% at 181.09 Mpy. For the largest NaCl corrosion rate occurred at 15 days immersion with a concentration of 0.1% from 101.171 Mpy, and the smallest corrosion rate at 5 days immersion with a concentration of 0.5% 41.793 Mpy.

1 INTRODUCTION

The use of recycled materials is currently widely used because raw materials are difficult and expensive. One option is to use aluminium waste known as scrap aluminium with consideration of being easily obtained and relatively inexpensive. The widespread use of aluminium scrap has been widely used both on a large scale such as the automotive industry, construction etc., as well as on a small scale such as household appliances. Before becoming a raw material, the casting process is first carried out. Casting is one of the processes of forming raw materials or work pieces by melting or melting metal in a melting furnace which is then put into a mold. Casting is a manufacturing process that uses metals and liquid molds to produce parts with shapes that are close to the final geometric shapes of

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the finished product (Surdia & Saito, 1986). To obtain the desired properties, usually aluminum scrap that has undergone a pouring process can be combined with various elements. Alloy elements are copper, silisium, magnesium, manganese, nickel and so on (Budiyono et al, 2012)

Metal corrosion is an event in which the metal undergoes oxidation while oxygen is reduced. Corrosion itself is an electrochemical process, which is a process that involves electricity. Certain parts of the metal act as anodes, while other parts act as cathodes. Electrons flow from the anode to the cathode so that corrosion occurs (Trethewey & Chamberlain, 1991). (Purnomo, 2004), conducting research by melting 320 aluminum alloys and pouring them into metal molds. Casting is repeated three times, and the casting results are then subjected to tensile test and impact test specimens. The results of tests carried out explain that re-casting will reduce the tensile strength and impact strength of the material. Andrayani (2017), examining the corrosion rate on aluminum before and after coated with cellulose acetate (CA) with immersion media HCl solution for 5 minutes showed that the corrosion rate that occurred very quickly where the lowest concentration (Molar) reached 0.05324 mm / year, This is because the HCl solution is a strong acid solution and the corrosion rate that occurs faster, the greater the concentration of the faster corrosion rate

2 Experimental

2.1 Material

This research uses alloy wheel waste then melted into scrap aluminum. Specimens were made with a size of 20 mm x 25 mm with a hole diameter of 30 mm

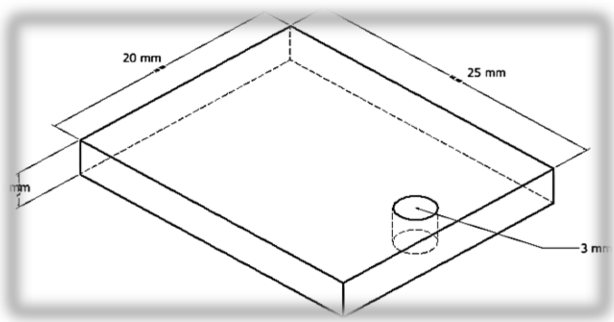


Figure 1. Test specimens

Tests carried out by Immersion use the ASTM G31-72 standard with the weight-loss method, where the data obtained is the difference in initial weight (before immersion) reduced by final weight (after immersion).

2.2 Corrosion rate

Media used are chloride acid (HCl) and sodium chloride (NaCl). chloride acid is used in the process of salt purification, porcelain cleaning, and as a stain remover on kitchen utensils. Sodium chloride (NaCl) is a salt that both contain chloride ions where chloride ions are corrosive. The specimen was immersed in a concentration of 0.1%; 0.3%; and 0.5% with an immersion time of 5 days, 10 days and 15 days

Corrosion rate is calculated according to the formula:

$$\text{Corrosion rate} = \frac{K \times W}{A \times T \times D} \quad (1)$$

With:
$K =$ Constanta
$T =$ time (hours)
$T =$ surface area (cm2)
$W =$ weight $-$ loss
$D =$ density (gram / cm3)

3 RESULTS AND DISCUSSION

The results of the study of HCl and NaCl immersion media with concentrations of 0.1%, 0.3% and 0.5%, can be seen as follows

3.1 Result

Table 3.1. Specimen weight

No	Consentration HCl	Initial weight (gr)			final weight (gr)		
		120 hours	240 hours	360 hours	120 hours	240 hours	360 hours
1	0,1%	4,050	4,218	4,239	2,919	2,510	2,453
2	0,3%	4,312	4,087	3,975	3,850	3,477	3,127
3	0,5%	3,992	4,424	4,225	3,783	4,129	3,829

No	Consentration NaCl	Initial weight (gr)			final weight (gr)		
		120 hours	240 hours	360 hours	120 hours	240 hours	360 hours
1	0.1%	3,55	3,505	3,504	3,377	3,25	3,149
2	0.3%	3,447	3,21	3,526	3,17	2,906	3,051
3	0.5%	2,927	3,379	3,451	2,733	3,226	3,136

Table 3.2 Weight-loss in immersion 120 hour, 240 hour, and 360 hour

No	Consentration HCl	Weight-loss (gr)		
		120 hours	240 hours	360 hours
1	0,1%	1.131	1.707	1.786
2	0,3%	0.462	0.610	0.847
3	0,5%	0.210	0.295	0.395

No	Consentration NaCl	Weight-loss (gr)		
		120 hours	240 hours	360 hours
1	0,1%	0.173	0.255	0.355
2	0,3%	0.277	0.304	0.475

3	0,5%	0.194	0.254	0.4053

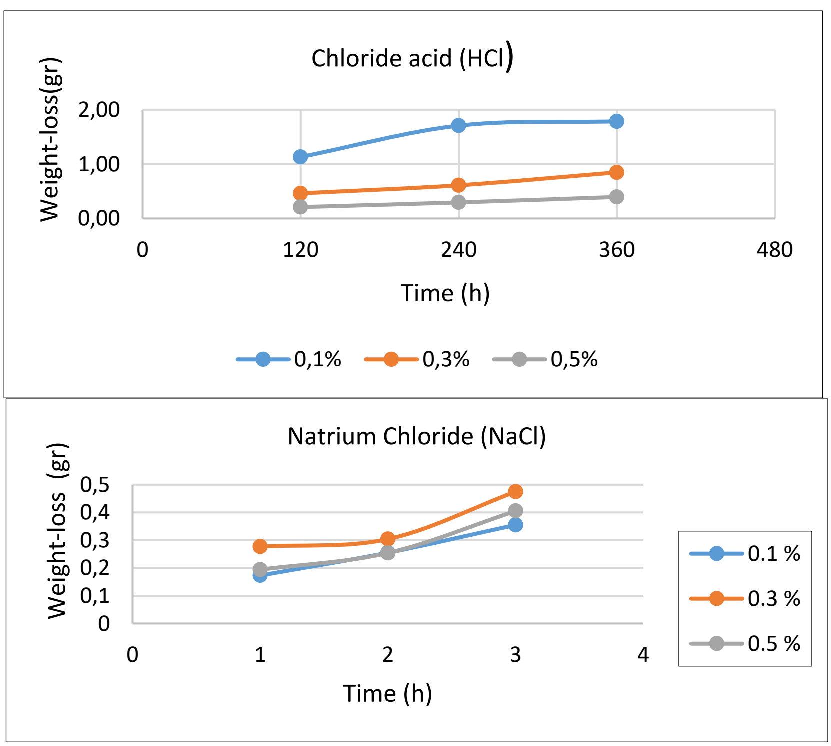
Table 3.3 Corrosion rate

No	Consentration HCl	Corrosion rate (mpy)		
		120 hours	240 hours	360 hours
1	0,1%	976,684	1474,381	1542,314
2	0,3%	398,964	526,770	731,721
3	0,5%	181,059	254,462	341,393

No	Consentration NaCl	Corrosion rate (mpy)		
		120 hours	240 hours	360 hours
1	0.1 %	53,689	79,14	110,171
2	0.3 %	26,2238	20,638	78,361
3	0.5 %	14,6895	17,07	41,793

3.2 Discussion

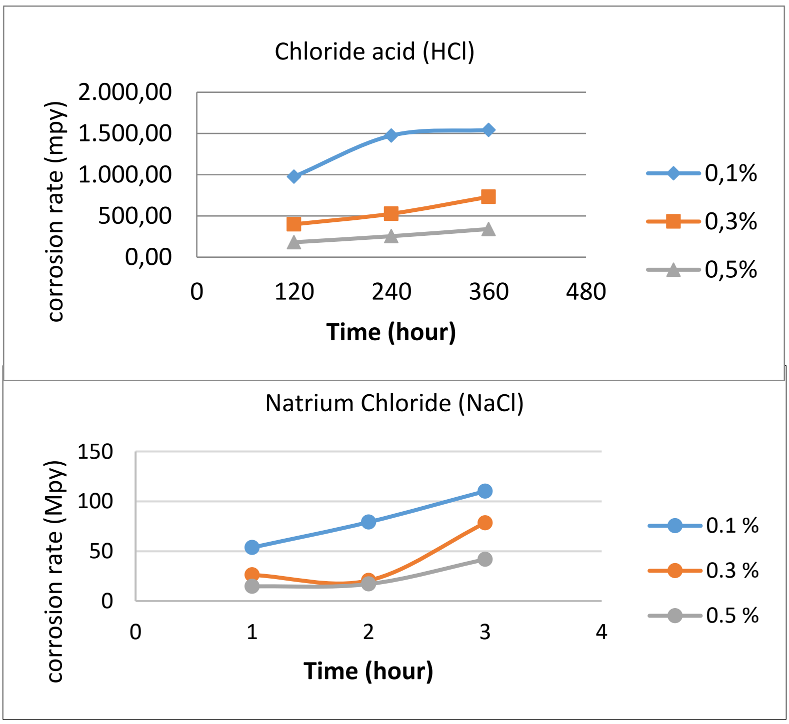
3.2.1 Weight loss



Pig 3.1. Chart Weight-loss HCl dan NaCl

From Pig. 3.1 can be seen that a significant weight reduction occurred at 120 hours this is due to the surface of the specimen that has not been coated with corrosion so that the corrosion rate that occurs at the immersion time of 120 hours is very large, while at the time of immersion from 120 to 240 hours has experienced a significant weight reduction lower than the immersion time of 120 hours this is due to part of the surface of the specimen has been coated with corrosion so that the reduction in weight is smaller than the immersion time of 120 hours, as well as the immersion time from 240 to 360 hours there is a lower weight reduction than the immersion time of 120 hours and time soaking 120 to 240 hours this is due to most of the surface of the specimen is coated with corrosion so that the reduction in weight is smaller than the soaking time of 120 hours and soaking time of 240 to 360 hours. Corrosion rate that occurs in the specimen is quite large, this is due to the immersion media used is chloride acid (HCl) and NaCl is a type of liquid containing Cl ions which can increase the corrosion rate.

3.2.2 Corrosion Rate



Pig 3.2. Chart corrosion rate HCl dan NaCl

From Fig 4.2 it can be seen the comparison between the time of immersion to corrosion rate using aquades media added with aqueous solution of chloride acid (HCl) and Natrium chloride (NaCl) 0.1%, 0.3%, and 0.5%. Where the immersion time is directly proportional to the corrosion rate, the longer the immersion time the corrosion rate increases. From Figure 4.1 the corrosion rate values obtained at the time of immersion of 120, 240 and 360 hours with concentrations of 0.1% are 976,684, 1474,381 and 1542,314 mpy, concentrations of 0.3% are 398,964, 526,770, and 731,721 mpy, and concentrations of 0.5% were 181,059, 254,462 and 341,393 mpy. From these data it can be seen that a significant weight reduction occurred at 120 hours this is due to the surface of the specimen that has not been coated with corrosion so that the corrosion rate that occurs at the immersion time of 120 hours is very large, while at the time of immersion from 120 to 240 hours has experienced a significant weight reduction lower than the immersion time of 120 hours this is due to part of the surface of the specimen has been coated with corrosion so that the reduction in weight is smaller than the immersion time of 120 hours, as well as the immersion time from 240 to 360 hours there is a lower weight reduction than the immersion time of 120 hours and time soaking 120 to 240 hours this is due to most of the surface of the specimen is coated with corrosion so that the reduction in weight is smaller than the soaking time of 120 hours and soaking time of 240 to 360 hours. The corrosion rate that occurs in the specimens is quite large, this is due to the immersion media used is chloride acid (HCl) is a type of strong acid liquid that can increase the rate of corrosion.

4 Conclusion

From the test results and discussion of the scrap scrap rate of aluminum using hydrochloric acid (HCl) and sodium chloride (NaCl) media with concentrations of 0.1%, 0.3%, and 0.5%, conclusions can be drawn:

The results of corrosion testing of scrap aluminum with chloride acid (HCl) compared to Natrium chloride (NaCl). The effect of the amount of Chloride acid (HCL) with a concentration of 0.1%, 0.3% and 0.5% indicates the greater the concentration, the corrosion that occurs will increase because it contains less acid.

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