

## Study of Aluminum using Coating Powder and Without Coating Powder on the Rate of Corrosion in HCL Solution on Aluminum Alloy 7075

Andi Dwi Ananda<sup>1\*</sup>, Hendri Louis Latif<sup>2</sup>, Agnes Erna Wahyu<sup>3</sup>, Hadi Prayitno<sup>4</sup>  
Politeknik Penerbangan di Makassar

**Corresponding Author:** Andi Dwi Ananda [andidwiananda@gmail.com](mailto:andidwiananda@gmail.com)

---

### ARTICLE INFO

*Keywords:* Alloy 7075, Powder Coating, HCL Solution, Rate Aluminum Corrosion, SEM Test

*Received :* 27, November

*Revised :* 29, December

*Accepted:* 30, January

©2025 Ananda, Latif, Wahyu, Prayitno : This is an open-access article distributed under the terms of the [Creative Commons Atribusi 4.0 Internasional](https://creativecommons.org/licenses/by/4.0/).



### ABSTRACT

Study This aims : 1) to find out results comparison rate corrosion between aluminum with powder coating and aluminum without powder coating to solution Sour Chloride , 2) knowing form Aluminum Alloy 7075 surface with powder coating and aluminum without powder coating to solution Sour Chloride , 3) produces impact test results to Aluminum Alloy 7075 with powder coating and aluminum without powder coating . Method research used is method type study descriptive quantitative . The data sources used is secondary data obtained direct from results study rate corrosion SEM testing and testing impact . Results from study This state that Aluminum Alloy 7075 with powder coating has rate more corrosion slow compared to without powder coating at the moment tested with HCl solution

---

## INTRODUCTION

Aluminum 7075, alloy aluminum which is often used in industry flight , known Because strength height and endurance its good corrosion . With strength pull maximum 280 MPa and density 2,810 g/cm<sup>3</sup>, this material is ideal for component aircraft like wings that need Power stand extra . However , even though own resilience corrosion natural , 7075 aluminum remains prone to to damage consequence interaction with rainwater , especially Because content sour chloride (HCl) which can accelerate the corrosion process .

Corrosion on aluminum often appear as stain vaginal discharge or gray on the surface metal , which if No handled can result in damage seriously . For prevent matter this , various method coating such as coatings are used , including powder coating. The powder coating process involves application paint powder which is then heated until melt For to form layer strong and durable protector . This offer more protection Good compared to painting liquid to corrosion , especially in condition corrosive like Rain sour . Study show that powder coating can give resilience corrosion until six times more Good compared to with painting liquid . This make it very effective method For protect component aircraft from damage consequence corrosion , ensuring age greater length and airworthiness Good For aircraft .

## LITERATURE REVIEW

Study This use method descriptive quantitative For test connection between variable through analysis statistics . Research design involving studies literature For runway theory , observation to rate corrosion on Aluminum Alloy 7075, as well as identification problem through speed test corrosion , SEM, and impact tests. Here is the flow diagram design study in detail.

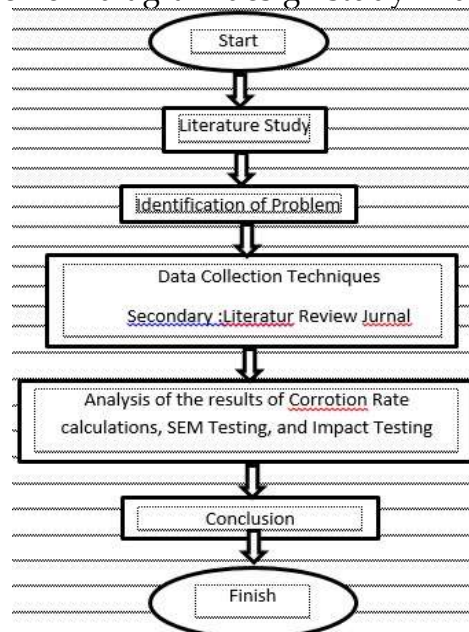


Figure.1 Flow Diagram

## METHODOLOGY

Variables tested consists of from variable free , namely corrosion on Aluminum Alloy 7075 in HCl solution , and variables bound , namely use of coating powder for hinder corrosion . Data collection techniques include studies literature and research with secondary data from corrosion , SEM, and impact tests . Data analysis was carried out in a way quantitative , and research implemented at the Polytechnic Flights from Makassar December 2023 to August 2024, covering proposal preparation , seminar, preparation tools , material testing, and results seminars .

## RESEARCH RESULT

Study about rate corrosion of aluminum alloy 7075 in HCl solution , good with and also without powder coating, showing subtraction heavy as results main .

**Table.1 Results Calculation Lost Weight of Test Material of Aluminum Alloy 7075 in Solution Hcl Without Powder Coating**

No.	Sample	Time (O'clock)	Heavy specimen before soaked (grams)	Heavy specimen after soaked	Lost Weight ( weight) early - heavy end )
1.	A2	48	18,781	18,342	0.439
2.	A3	96	18,781	17,613	1.168
3.	A4	144	18,781	15,931	2,850

Based on table above , below calculation rate corrosion use formula as following

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

Information :

K : Constant ( mpy )

T : Time of exposure (hours)

A : The surface area that is soaked ( cm <sup>2</sup> )

W : Lost weight (grams)

D : Density (gr/cm <sup>2</sup> )

It is known :

K : 3.45 x 10 <sup>6</sup>

T <sub>2</sub> : 48 hours

A : 6 x 1 = 6 cm <sup>2</sup>

W : 0.439 grams

D : 2.7 gr/cm <sup>3</sup>

So :

$$CR = \frac{3,45 \times 10^6 \times 0,439}{6 \times 48 \times 2,7}$$

$$= \frac{1514550}{777,6}$$

$$: 1947.72 \text{ mpy}$$

It is known :

K :  $3.45 \times 10^6$   
 $T_3$  : 96 hours  
A :  $6 \times 1 = 6 \text{ cm}^2$   
W : 1,168 grams  
D : 2.7 grams /  $\text{cm}^3$

So :

$$CR = \frac{3,45 \times 10^6 \times 1,168}{6 \times 96 \times 2,7}$$

$$= \frac{4032600}{1555,2}$$

$$: 2592.97 \text{ mpy}$$

It is known :

K :  $3.45 \times 10^6$   
 $T_3$  : 144 hours  
A :  $6 \times 1 = 6 \text{ cm}^2$   
W : 2,850 grams  
D : 2.7 grams /  $\text{cm}^3$

So :

$$CR = \frac{3,45 \times 10^6 \times 2,850}{6 \times 144 \times 2,7}$$

$$= \frac{9832500}{2332,8}$$

$$: 4214.89 \text{ mpy} .$$

**Table .2 Results Calculation Lost Weight of Test Material of Aluminum Alloy 7075 in Solution Hcl With Powder Coating.**

No.	Sample	Time (O'clock)	Heavy specimen before soaked (grams)	Heavy specimen after soaked	Lost Weight (weight) early - heavy end
1.	B2	48	19,631	19.125	0.506
2.	B3	96	19,631	18,461	1,170
3.	B4	144	19,631	17,709	1,922

Based on table above , below calculation rate corrosion use formula as following

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

Information :

K : Constant ( mpy )

T : Time of exposure (hours)

A : The surface area that is soaked ( cm <sup>2</sup> )

W : Lost weight (grams)

D : Density (gr/cm <sup>2</sup> )

It is known :

K : 3.45 x 10<sup>6</sup> mpy

T1 : 48 hours

A : 6 x 1 = 6 cm<sup>2</sup>

W : 0.506 grams

D : 2.7 gr/cm<sup>3</sup>

So :

$$\begin{aligned} \text{CR} &: \frac{3,45 \times 10^6 \times 0,506}{6 \times 48 \times 2,7} \\ &: \frac{1742700}{777,6} \\ &: 2241.12 \text{ mpy} \end{aligned}$$

It is known :

K : 3.45 x 10<sup>6</sup> mpy

T2 : 96 hours

A : 6 x 1 = 6 cm<sup>2</sup>

W : 1,170 grams

D : 2.7 gr/cm<sup>3</sup>

So :

$$\begin{aligned} \text{CR} &: \frac{3,45 \times 10^6 \times 1,170}{6 \times 96 \times 2,7} \\ &: \frac{4036500}{1555,2} \\ &: 2595.48 \text{ mpy} \end{aligned}$$

It is known :

K : 3.45 x 10<sup>6</sup> mpy

T3 : 144 hours



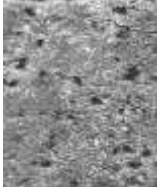

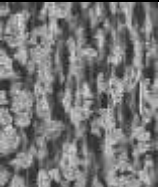

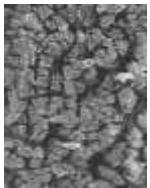

A : 6 x 1 = 6 cm <sup>2</sup>

W : 1.922 grams

D : 2.7 gr/cm <sup>3</sup>

$$\begin{aligned} \text{So} &: \\ \text{CR} &: \frac{3,45 \times 10^6 \times 1,922}{6 \times 144 \times 2,7} \\ &: \frac{6629100}{2332,8} \\ &: 2841.69 \text{ mpy} \end{aligned}$$

**Table.3 Comparison Results Testing Scanning Electron Microscope Uses Aluminum Alloy 7075 with Powder Coating and Without Powder Coating**

No.	Testing Time	Aluminum 7075 without <i>powder coating</i>	Aluminum 7075 with <i>powder coating</i>
1.	0 hours	 (A1)	 (B1)
2.	48 hours	 (A2)	 (B2)
3.	96 hours	 (A3)	 (B3)
4.	144 hours	 (A4)	 (B4)

Following results calculation *impact test* of aluminum alloy 7075 without soaked *powder coating* in solution HCl .

- 1) Aluminum Alloy 7075 without *powder coating* soaked for 48 hours of use HCl solution .

When testing corner deviation pendulum after hit Aluminum Alloy 7075 is  $96.79^\circ$  .

$$\begin{aligned} W &= g R G (\cos \beta - \cos \alpha) \\ &= 9.8 \times 0.95 \times 1.7 (\cos 96.79^\circ - \cos 160^\circ) \\ &= 9.8 \times 0.95 \times 1.7 (-0.1086 - (-0.93)) \\ &= 15.827 (0.8214) \\ &= 13 \text{ J} \end{aligned}$$

$$H = \frac{W}{A} = \frac{14}{100} = 0.14 \text{ J}$$

- 2) Aluminum Alloy 7075 without *powder coating* soaked for 96 hours of use HCl solution

When testing corner deviation pendulum after hit Aluminum Alloy 7075 is 111.78 °.

$$\begin{aligned} W &= g R G (\cos \beta - \cos \alpha) \\ &= 9.8 \times 0.95 \times 1.7 (\cos 111.78^\circ - \cos 160^\circ) \\ &= 9.8 \times 0.95 \times 1.7 (-0.3615 - (-0.93)) \\ &= 15,827 (0.5685) \\ &= 9 \text{ J} \end{aligned}$$

$$H = \frac{W}{A} = \frac{9}{100} = 0.09 \text{ J}$$

- 3) Aluminum Alloy 7075 without *powder coating* soaked for 144 hours of use HCl solution

When testing corner deviation pendulum after hit Aluminum Alloy 7075 is 116.2 °.

$$\begin{aligned} W &= g R G (\cos \beta - \cos \alpha) \\ &= 9.8 \times 0.95 \times 1.7 (\cos 116.2^\circ - \cos 160^\circ) \\ &= 9.8 \times 0.95 \times 1.7 (-0.4245 - (-0.93)) \\ &= 15,827 (0.5055) \\ &= 8 \text{ J} \end{aligned}$$

$$H = \frac{W}{A} = \frac{8}{100} = 0.08 \text{ J}$$

Following table results impact test calculation .

**Table.4 Results Impact Test Calculation**

Specimen	$\alpha$	$\beta$	M (kg)	g (m/s <sup>2</sup> )	R (m)	W (joules)	A (mm <sup>2</sup> )	H (J/mm <sup>2</sup> )
A2	160°	96.79°	1.7	9.8	0.95	13	100	0.13
A3	160°	111.78°	1.7	9.8	0.95	9	100	0.09
A4	160°	116.2°	1.7	9.8	0.95	8	100	0.08

Impact test calculation results aluminum alloy 7075 with soaked powder coating in HCl solution .

- 1) Aluminum Alloy 7075 with *powder coating* soaked for 48 hours of use HCl solution

When testing corner deviation pendulum after hit Aluminum Alloy 7075 is  $93.16^\circ$ .

$$\begin{aligned} W &= g R G (\cos \beta - \cos \alpha) \\ &= 9.8 \times 0.95 \times 1.7 (\cos 93,160 - \cos 1600) \\ &= 9.8 \times 0.95 \times 1.7 ( - 0.0464 - (-0.93)) \\ &= 15.827 (0.8836) \\ &= 14 \text{ J} \end{aligned}$$

$$\begin{aligned} H &= \frac{W}{A} \\ &= \frac{14}{100} \\ &= 0.14 \text{ J} \end{aligned}$$

- 2) Aluminum Alloy 7075 with *powder coating* soaked for 96 hours of use HCl solution

When testing corner deviation pendulum after hit Aluminum Alloy 7075 is  $96.79^\circ$ .

$$\begin{aligned} W &= g R G (\cos \beta - \cos \alpha) \\ &= 9.8 \times 0.95 \times 1.7 (\cos 96,790 - \cos 1600) \\ &= 9.8 \times 0.95 \times 1.7 ( - 0.1086 - (-0.93)) \\ &= 15.827 (0.8214) \\ &= 13 \text{ J} \end{aligned}$$

$$\begin{aligned} H &= \frac{W}{A} \\ &= \frac{13}{100} \\ &= 0.13 \text{ J} \end{aligned}$$

- 3) Aluminum Alloy 7075 with *powder coating* soaked for 144 hours of use HCl solution

When testing corner deviation pendulum after hit Aluminum Alloy 7075 is  $40.78^\circ$ .

$$\begin{aligned} W &= g R G (\cos \beta - \cos \alpha) \\ &= 9.8 \times 0.03 \times 1.7 (\cos 40,780 - \cos 1600) \\ &= 9.8 \times 0.03 \times 1.7 ( - 0.1717 - (-0.93)) \\ &= 15.827 (0.7583) \\ &= 12 \text{ J} \end{aligned}$$

$$\begin{aligned} H &= \frac{W}{A} \\ &= \frac{12}{100} \\ &= 0.12 \text{ J} \end{aligned}$$

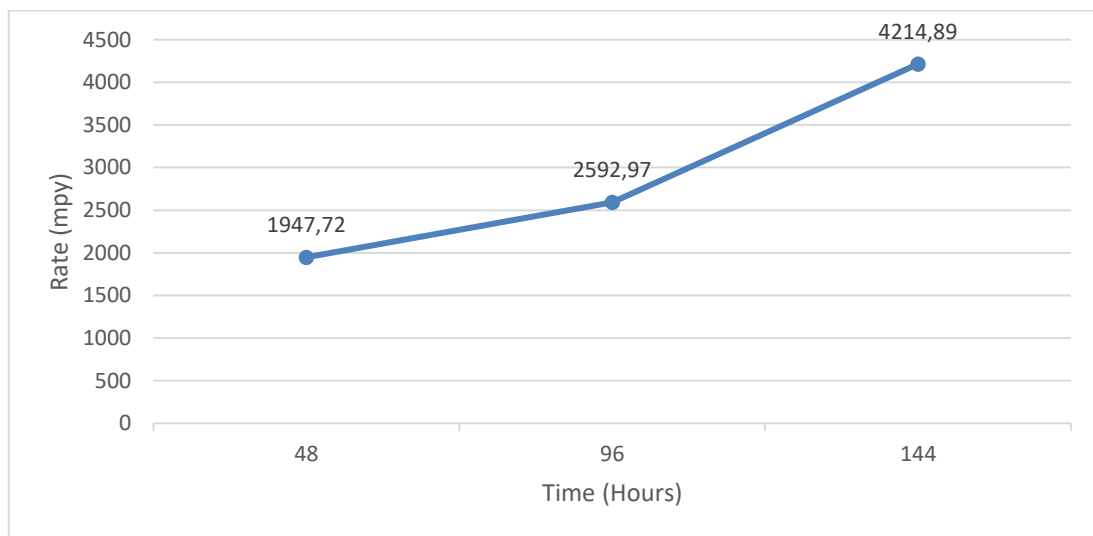
Here are the results data impact test calculation .

**Table.5 Results Data Impact Test Calculation**

Specimen	$\alpha$	$\beta$	M (kg)	$\frac{g}{(m/s^2)}$	R (m)	W (joules)	A (mm)	H (j/mm <sup>2</sup> )
B2	160 °	93.16 °	1.7	9.8	0.95	14	100	0.14
B3	160 °	96.79 °	1.7	9.8	0.95	13	100	0.13
B4	160 °	40.78 °	1.7	9.8	0.95	12	100	0.12

## DISCUSSION

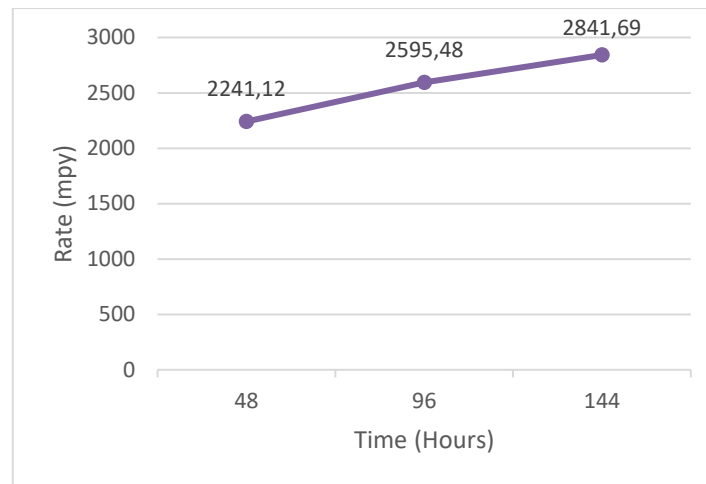
Calculation Result Graph Lost Weight of Test Material of Aluminum Alloy 7075 Without Powder Coating After Dissolved in HCl solution .



**Figure.1 Test Material of Aluminum Alloy**

Based on the data above , the rate corrosion highest for 7075 aluminum without powder coating recorded on immersion for 144 hours with value 4,214.89 mpy , while rate corrosion lowest recorded at 48 hours immersion with value 1,947.72 mpy . This data obtained through weight loss method , which measures change heavy specimen during the research process .

Calculation Result Graph Lost Weight of Test Material Aluminum Alloy 7075 With Powder Coating After Dissolved in HCL solution .

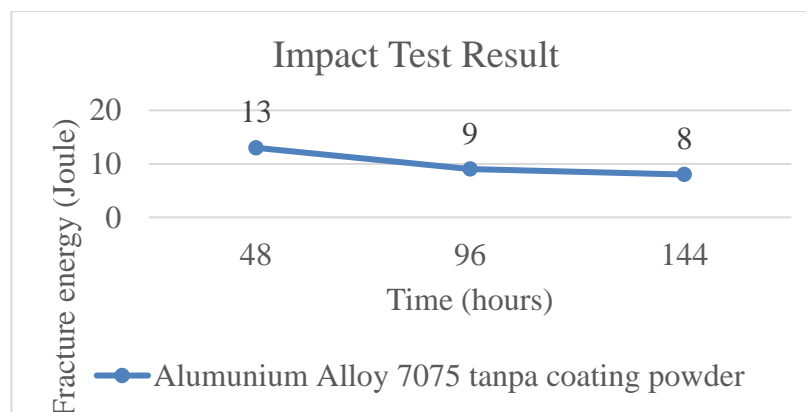


**Figure.1 Result Graph Lost Weight**

Based on the data above , the value calculation lost heavy For aluminum alloy 7075 with powder coating against HCl solution for 144 hours showed that rate corrosion highest occurred at 144 hours with value 2,841.69 mpy , while rate corrosion lowest occurred within 48 hours with value 2,241.12 mpy . Comparison between aluminum alloy 7075 with powder coating and without powder coating shows that rate corrosion without further powder coating high , reaching 4,214.89 mpy at 144 hours, compared to with rate corrosion with powder coating of 2,841.69 mpy . The difference rate corrosion between second type specimen is 1,373.2 mpy , which shows that powder coating is effective in reduce rate corrosion .

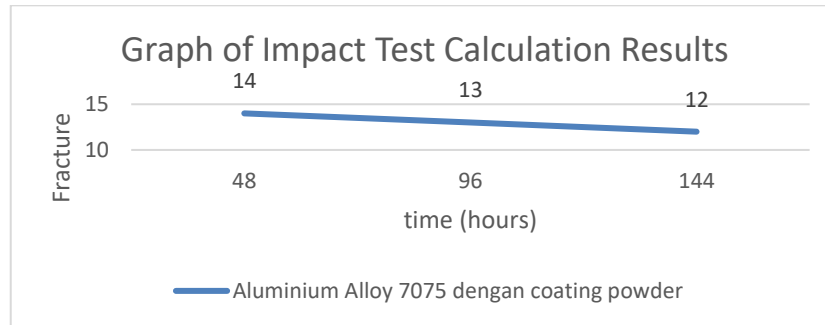
Test results using a Scanning Electron Microscope (SEM) shows that the 7075 Aluminum Alloy coated with powder coating is more stand to corrosion compared to the one without powder coating after soaked in HCl solution for 144 hours. Based on the image obtained , both the type of material showing pitting corrosion, namely corrosion local causing formation hole small that is not regular on the surface . Changes The physical properties observed in both materials show that powder coating provides protection addition against pitting corrosion on Aluminum Alloy 7075.

Chart results calculation *impact test* of 7075 aluminum immersed in HCl solution .



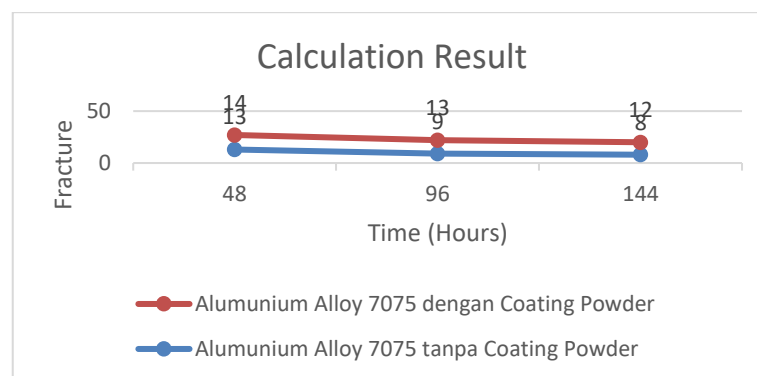
**Figure.2 Chart Results Calculation Impact Test of 7075 Aluminum Immersed in HCL Solution**

Impact test results on soaked Aluminum Alloy 7075 in HCl solution shows that strength broken decrease along with increase time immersion . The specimen is immersed for 48 hours shows power broken of 0.14 J, while the one immersed for 96 hours experienced decline to 0.09 J, and the soaked for 144 hours recorded power broken lowest which is 0.08 J. This data , which is depicted in graph , shows that the longer the soaking , the more low material strength , indicating that the material becomes more easy broken along increase time contact with HCl solution .



**Figure.3 Graphic Results Impact Test Calculation**

Impact test results on Aluminum Alloy 7075 with powder coating show that power broken decrease along with increase time immersion in HCl solution . The graphs in Table 4 and Figure 4 show that soaked specimen for 144 hours have power broken lowest , namely 12 Joules, compared to with soaked specimen for 48 hours. Decrease power broken This indicates that the longer the soaking , the more easy material breaks , because decline weight of material due to corrosion .



**Figure.4 Results Show that in Aluminum Alloy 7075**

Impact test results show that in Aluminum Alloy 7075, both those coated with powder coating and those without powder coating, the strength broken decrease along with increase time immersion in HCl solution . However , the use of powder coating slows down corrosion and cause improvement power broken compared to with specimen without powder coating. This is show that powder coating is effective in hinder corrosion and maintenance greater material strength Good during immersion .

## CONCLUSIONS AND RECOMMENDATIONS

From the research conducted , it can be concluded that powder coating is significant reduce rate corrosion on Aluminum Alloy 7075 compared with the not coated . Tests show that rate Corrosion on Aluminum Alloy 7075 with powder coating reached 2841.69 mpy , far more low compared to 4214.89 mpy on the one without powder coating after immersion for 144 hours in HCl solution. SEM testing confirmed that The surface of Aluminum Alloy 7075 without powder coating shows more corrosion fast , with type pitting corrosion that causes holes small . Besides that , impact test shows that Aluminum Alloy 7075 with powder coating has more resilience good and more strong compared to with the one without powder coating, because powder coating layer slows down rate corrosion and increase material strength .

## ADVANCED RESEARCH

Every study have limitations ; with Thus , it is necessary use coating powder For increase Corrosion resistance of Aluminum Alloy 7075 especially in environments containing HCl because can in a way significant reduce rate corrosion and prolongation material age . Should do SEM ( Scanning) testing Electron Microscope ) on Aluminum Alloy 7075 which has been coated powder in a way routine to ensure that pitting corrosion does not occur which could damage the material structure. Should do inspection *powder coating* on Aluminum Alloy 7075 is always in good condition and is regularly updated every 6-12 months to maintain material strength and slow the corrosion rate, especially in corrosive environments such as those containing HCl .

## ACKNOWLEDGMENT

I say accept the greatest love to lecturer mentor I who have give guidance and advice in the writing process journal this . With help he , me Can finish writing This with Good.

## REFERENCES

- Arifullah , M., & Widyastuti , I. (2015). Rate Carbon Steel Corrosion Resulting from Powder Coating and Painting Liquid .
- Borg , W.R. & Gall, M.D. (1983). Educational research: An introduction. Fourth Edition. New York: Longman.
- Chamberlain , J. (1991). Corrosion and Its Prevention . Jakarta: Publisher Science and Technology
- Chamberlain , J. (1991). Corrosion For Students and Engineers . Jakarta: PT. Gramedia Pustaka Utama.
- Eyes , N. (2020). Book Material Scanning Electron Microscopy Learning . Jakarta: BMP UKI

- Fadholi , A. (2013). Study Influence Temperature and Air Pressure Against Power Lift Airplane At S Airport . Babullah Ternate. Theory and Application Physics , 01 (02), 121–130.
- Federal Aviation Administration. (2018). Aviation Maintenance Technician Handbook - General. In Aviation Maintenance Technician Handbook - Airframe (Vol. 1). Oklahoma City : US Department of Transportation, Federal Aviation Administration, Flight Standards Service.
- Fontana , Mars Guy. (1986). Corrosion Engineering . Singapore:Mc -Graw-Hill Book Co.
- George , Dieter. (1987). Metallurgy Mechanic . Jakarta : The Great
- Greenwood , Norman N.; Earnshaw, Alan (1997). Chemistry of the Elements (2nd ed.) . UK: Butterworth - Heinemann .
- Hull , D., & Clyne, T. W. (1996). An Introduction to Composite Materials. Cambridge University Press.
- Iswanto , Priyo Tri. (2015). Physical and Mechanical Properties of Aircraft Material Aluminum 7050-T7651 With Shot Peening And Chromic Acid Anodizing Treatment Assrul Fii , 2–3.
- Masta , N. (2020). Book Material Scanning Electron Microscopy Learning . Jakarta: Indonesian Christian University
- Rosyidin , A. (2017). Improvement , Impact Corrosion On Boeing 737 Aircraft . Combustion Engine: Journal of Mechanical Engineering , 1 (1). <https://doi.org/10.31000/mbjtm.v1i1.183>
- Shevla , G. (1990). Textbook of Analysis Inorganic Qualitative Macro and Semi Micro Part I. Jakarta : PT Kalman Media Pustaka
- Sugiono , PD (2014). Educational research methods quantitative approach.pdf. In Educational Research Methods Quantitative, Qualitative and R&D Approaches .

- Supriadi , A. (2020). Development Machine The Movers Sieve Powder Remainder Powder Coating with Method Vibration . Development Machine The Movers Sieve Powder Remaining Powder Coating With Method Vibration . Jakarta: PT Media Pustaka
- Surdia , Tata; Saito Shinroku . (1999). Knowledge Engineering Materials . Jakarta: Pradnya Paramita
- Swastika . (2019). Chapter II Basis Theory . Journal of Chemical Information and Modeling , 53 (9), 1689–1699.
- Syamsudin , A. (2015). Quantitative-Qualitative-Research-Methods.Pdf. Journal of Childhood Education , 3 (1), 403–413.