RRA#**B-milled** samples in 1 M HCl solution for interval time included 24 h, 48 h and 72 h.

Table 3: Corrosion rate of **A** PM alloy samples for different procedures in HCL solution.

Alloys	Types of procedures	Corrosion rate* 10E-01 (mm/y)		
		After 24h exposure	After 48h exposure	After 72h exposure
PM Milled B	As sintered B-milled	35.094	25.918	23.473
	T6#B-milled	24.346	20.975	18.496
	RRA#B-milled	21.165	17.678	16.502

After corrosion test conducted on PM Al-alloys **A** and **B**, corrosion rates were calculated of alloy **B** under different treatments for various durations in HCl solution as shown in Figure 2. It can be explained that the rates of corrosion for the aging temper at T6#**B-milled** and RRA#**B-milled** during 24 hours which are decreased than as sintered **A-milled** about of 31% and 35% respectively.

On the other hand, corrosion resistance of as sintered **B-Milled**, T6#**B-milled** and RRA#**B-milled** more than as sintered **A-Milled**, T6#**A-milled** and RRA#**A-milled** under the same operation conditions. Increasing in corrosion resistance of PM Al-alloy **B** owing distribution of the Al-Ni intermetallic compounds created during Al-matrix due to the role of mechanical alloying in the increasing solubility of Ni with aluminum [13].

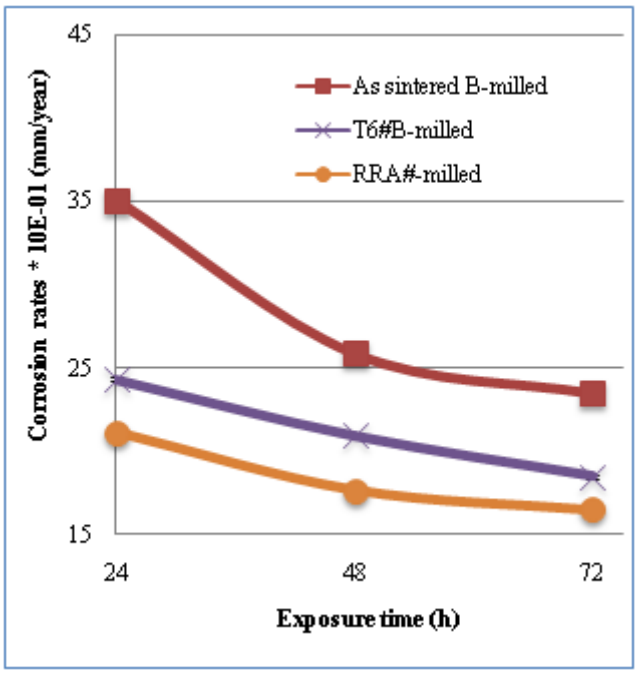


Figure 2: Graphs of corrosion rates of an alloy **B** underwent different treatments vs. exposure time in 1 M HCl solution.

Aburada et al [20] reported that the beneficial of addition of nickel alloying in pitting resistance wherein alteration in repassivation potential. Moreover, it can be seen that in each case as in Figures 1 and 2, there is a decrease in corrosion rate with increase in duration of exposure to the corrodent, implying that the corrosion resistance of the materials tested increases as the exposure time is increased.

Visible inspection showed that there were no hydrogen bubbles clinging onto the surface of the test specimens. The phenomenon of monotonically decreasing corrosion rate with respect to time indicates some passivation of the matrix alloy. Garcia et al [21] observed in the suit of localized corrosion in HCl solution, the surfaces of aluminum alloys are passive and back up a relatively thick alumina film that does not allow hydrogen to evolve.

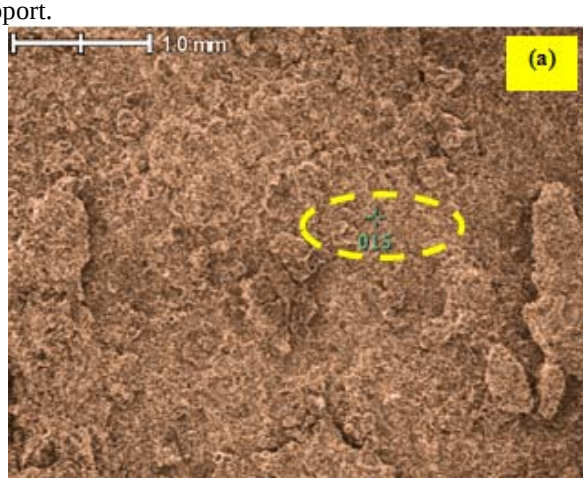
Ma et al [22] believe that the black film formed on the surface consists of an Al hydrated oxide compound which protects the bulk stuff from further corrosion in the acid medium. The SEM micrograph of PM Al-alloy **A** sample after T6 as shown in Figure 3a reveals corroded surface of aluminum matrix. The α-Al with existent major alloying elements of Zn, Mg and Cu which are evident as presented in Figure 3b. Further, the presence high percentage of chloride ions due to reactions taken place in the base alloy during the immersed in acidic medium as mentioned former (Eq. 5 and 6). The SEM image for PM Al-alloy **B** after RRA in Figure 4a show that dark area as α-Al matrix as well as dispersion particles as light which consist of the intercompounds and precipitations. Figure 4b reveals the EDS spectrum the having of nickel element as evidence about create compounds.

4. Conclusions

The results for this study reveals that corrosion rate is decreased of PM milled Al-alloy **A** samples after applying the aging; retrogression and reaging. On the other hand, regard to PM milled alloys underwent to the aging at T6 and RRA possesses corrosion resistance higher than as sintered samples, due to the precipitation phases of alloying elements are occurred.Furthermore, Corrosion resistance of PM milled Al-alloy **B** is enhanced more than alloy **A** due to the additions of nickel led to create dispersion intermetallics as well the precipitations particles.

5. Acknowledgements

This work supported under University Malaysia Perlis (UniMAP). The authors greatly thank for Ministry of Higher Education and Scientific Research in Iraq for the continuous support.



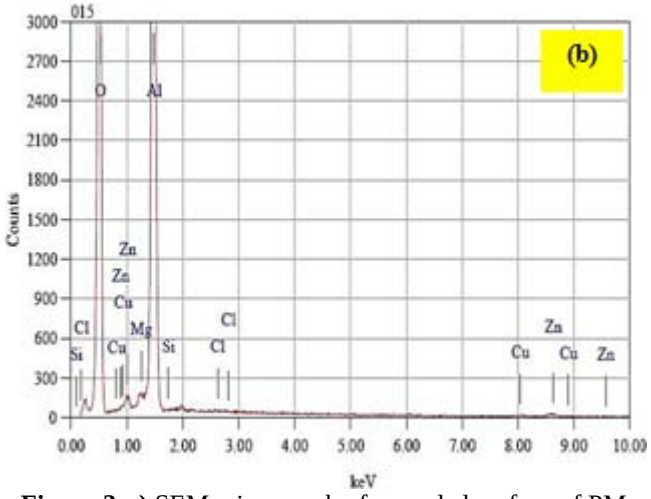


Figure 3:a) SEM micrograph of corroded surface of PM milled Al-alloy **A** in 1 M HCl solution after 72 hours; and **b)** Corresponding EDS analysis showing the attacked surface and chemical composition of corroded surface.

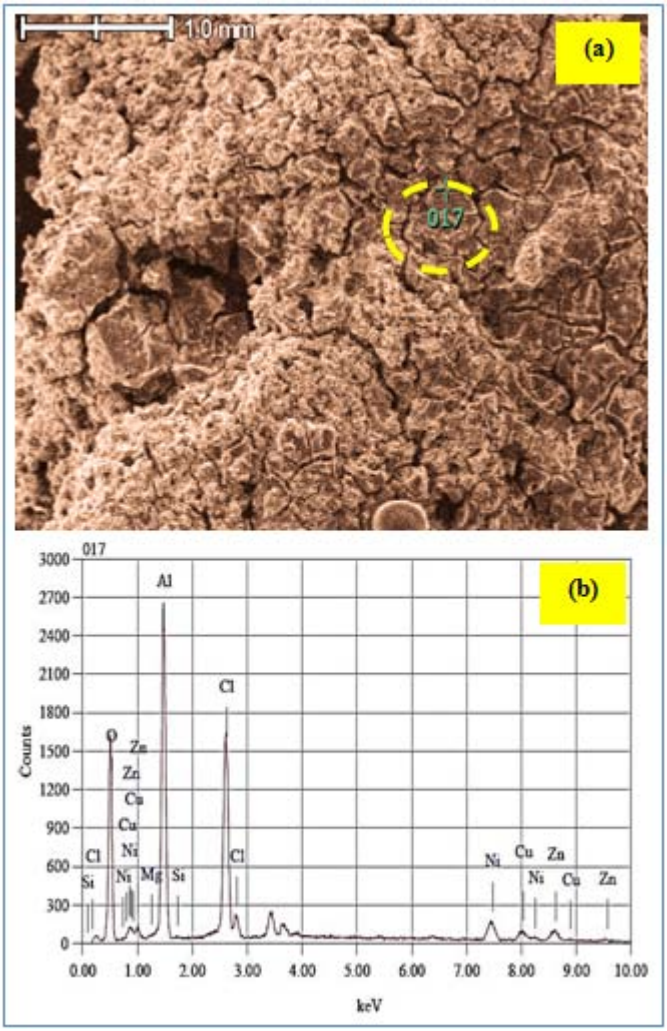


Figure 4:a) SEM micrograph of corroded surface of PM milled Al-alloy **B**, in 1 M HCl solution after 72 hours; and **b)** Corresponding EDS analysis showing the attacked surface and chemical composition of corroded surface.

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