

V. Scally Rate of reaction Lab report

by Vick Scally

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UWTSD
OME DEGREE COURSE

Victoria C. Scally

Rate of Reaction

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1. INTRODUCTION

Rate of Reaction

The rate at which reactions occur are an important part of chemical reactions and understanding what is happening between certain substances.

The rates of reactions can be effected by various factors, ie. Temperature and concentration of substance. These may act as a catalyst and speed up reactions.



Knowing how these factors effect reaction is crucial in the prediction and control of chemical reactions. This in turn can ensure that a reaction can be carried out in the most effective conditions, most safe conditions and also help to prevent accidents when certain chemicals come into contact with one another and react in a potentially hazardous way.

very good explanation

The reactions discussed in this paper are the reactions of hydrochloric acid (HCl) and Magnesium metal (Mg). The volume of Hydrogen gas (H₂) is measured and the variables used within the experiment are HCl concentration, Temperature and the surface area of Mg metal.

would be very good if you wrote the balanced chemical equation

what are the control variables?

Results

1. HCl concentration



Table 1 - HCl concentration on H2 production

unit of molarity is M=mol/L, not mol

Time (s)	Reaction at .5 Mol HCl (mL)	Reaction at 1 mol HCl (mL)	Reaction at 1.5mol HCl (mL)	Reaction at 2 mol HCl (mL)
10	2.1	24	21	36
20	3.1	26	34	51
30	4.5	37	46	56
40	5.6	43	51	63
50	6.5	48	55	67
60	7.8	52	59	70
70	9	57	62.5	71
80	10	60	65	71
90	11.2	63	67	71
100	12	65	69	
110	13	65	70	
120	14	65	71	
130	15	65	71	
140	15.8	65		
150	16.9	67		
160	18	67		
150	18.6	67		
180	19.1	67		
190	20.2	67		
200	21	67		
210	21.8	67		
220	22.5	67		
230	23.7	67		
240	24.3	67		
250	25	67		
260	26.1	67		
270	27	67		
280	27.7	67		
290	28.5	67		
300	29.1	67		
310	30	67		
320	30.9	67		
330	31.6	67		
380	32.2	68		
880	49			

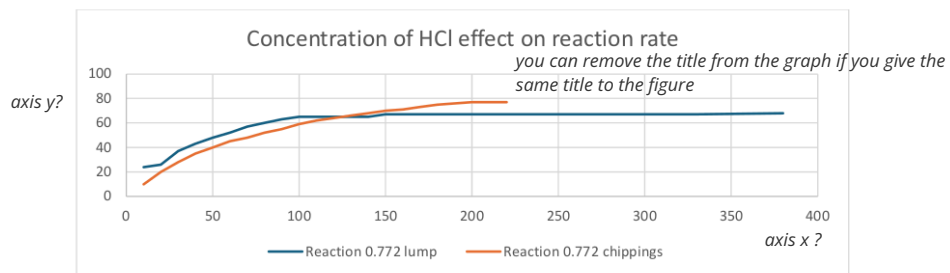


Figure 1- HCl Concentration on H2 production

this is wrong plot for this experiment!

2. Temperature.

Table 2- Effect of temperature on reaction

Time (s)	Gas produced mL at 70° (mL)	Gas Produced mL at 95° (mL)
10	25	20
20	40	32
30	50	40
40	56	45
50	60	49
60	62	52
70	64	54
80	65	57
90	66	59
100	66	62
110	68	63
120	69	64
130	70	65
140	70	66
150	71	67
160	71	68
170	71	68
180	71	68

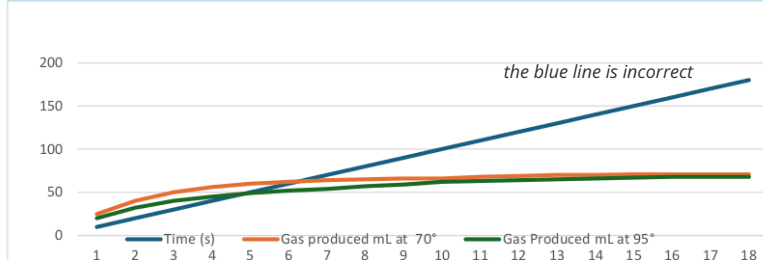


Figure 2- Effect of temperature on reaction

Surface area

Table 3- Effect of surface area on reaction rate

Time (s)	<i>g</i>	
	Reaction 0.772 lump (mL)	Reaction 0.772 chippings (mL)
10	24	10
20	26	20
30	37	28
40	43	35
50	48	40
60	52	45
70	57	48
80	60	52
90	63	55
100	65	59
110	65	62
120	65	64
130	65	66
140	65	68
150	67	70
160	67	71
170	67	73
180	67	75
190	67	76
200	67	77
210	67	77
220	67	77
230	67	
240	67	
250	67	
260	67	
270	67	
280	67	
290	67	
300	67	
310	67	
320	67	
330	67	
380	68	

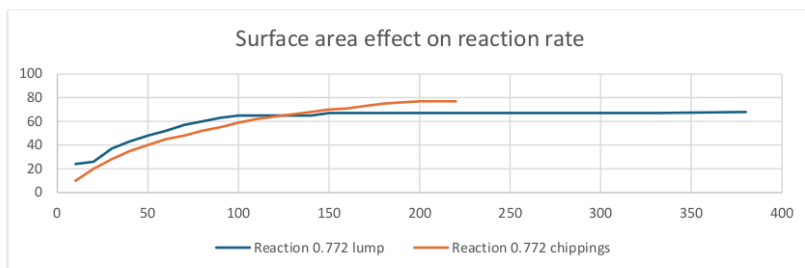


Figure 3- Effect of surface area on reaction rate

Discussion

1. Effect of HCl concentration on the speed of H₂ production

As seen in Table 1, Figure 1 the effects of HCl concentration on reaction rate are clear and as expected. The higher the concentration of the acid the quicker the rate of the reaction on the Mg. This is shown by the production of Hydrogen gas.

As there are more molecules within the higher concentration gas there are more molecules to react with the magnesium, therefore speeding up or catalysing the reaction. *catalyst decreases activation energy; increased concentration facilitates successful collisions between the molecules/ions; these are two different processes!*

2. Effect of temperature on the speed of H₂ production

As seen in Table 2, Figure 2 the effect of temperature on the reaction rate are not expected. It is expected that a rise in temperature will increase the reaction speed due to the speed at which particles move being increased. [1]

Since Magnesium oxidises in air it is possible that the second reaction is affected by the oxidised layer covering the metal, although the metal was 'sanded' prior to the experiment it is possible it was not done to the same standard in each case. As the metal in both reactions was the same weight it is also possible that their shape/surface area was not identical and therefore effected the results.

In the correct circumstances the reaction rate will be increased by the increase of temperature, the particles in the HCl will move faster and therefore react with the magnesium at a faster rate. [2]

3. The effect of Surface area on reaction rate.

As seen in Table 3, Figure 3 the reaction rate of the HCl on the magnesium produced the Hydrogen gas at a much faster rate on the magnesium chippings in oppose to the lump on magnesium. This is due to the surface area being larger as the piece

are smaller and have less mass per cm. The HCl is therefore able to react with more of the magnesium and therefore creates the gas at a faster rate than with the larger piece with a smaller surface area.

Relevance to OME

The relevance of the reaction rates of certain chemicals and metals is extremely important in the relevance to OME. Due to the oxidation of some metals, it is possible for some explosives to degrade at a faster rate, if this happens the reaction of the explosive will therefore be affected. This knowledge ensures that explosives are kept in the appropriate manner, at the correct temperature and packing to ensure their quality is maintained. It also ensures that explosives do not come into contact with certain substances and react in an unwanted manner. [3]

Reaction rates are also important to note in the creation of effective explosives. If a certain explosive reacts to the environment in a specific way it is important to ensure its casing can protect it in the most efficient way possible until such a time that it is activated.

Conclusion

As seen in the results reaction rates can be significantly affected by a number of factors. It is therefore important to ensure that when working with specific chemicals it is done in a safe and effective manner.

Although not shown in the reaction results, increased temperatures will increase the rate of a reaction, increased surface areas will also increase the rate of a reaction and additionally using higher concentrations of acids will also increase the rate of a reaction.

Reactions can therefore be controlled by these factors and manipulated to suit our needs.

This is important in the OME industry in the production of effective explosives, and the storage and creation of the appropriate casings.

References

1. J.-C. Tang, A. Shibata, Q. Zhou, and A. Katayama, "Effect of temperature on reaction rate and microbial community in composting of cattle manure with rice straw," *Journal of Bioscience and Bioengineering*, vol. 104, no. 4, pp. 321–328, Oct. 2007, doi: <https://doi.org/10.1263/jbb.104.321>. (accessed 09/05/25)
2. B. Roald and W. Beck, "The Dissolution of Magnesium in Hydrochloric Acid," *Journal of The Electrochemical Society*, vol. 98, no. 7, p. 277, 1951, doi: <https://doi.org/10.1149/1.2778207>. (accessed 09/05/2025)
3. J. A. MacDonald, M. J. Small, and M. G. Morgan, "Quantifying the Risks of Unexploded Ordnance at Closed Military Bases," *Environmental Science & Technology*, vol. 43, no. 2, pp. 259–265, Dec. 2008, doi: <https://doi.org/10.1021/es8014106>. (accessed 09/05/2025)
4. L. A. Kingston, "Investigation of enhanced aluminium casings for underwater explosives and development of spectroscopic techniques for measuring temperature in environments relevant to underwater ordnance - ProQuest," Proquest.com, 2025.
<https://www.proquest.com/openview/b15be2d5a4c03a7087a783ec59e5940c/1?cbl=18750&pq-origsite=gscholar> (accessed May 09, 2025).

Appendix

Materials

Long test tube with arm	0.5, 1, 1.5, 2 mol HCl solutions
Gas Syringe	Mg ribbons
Rubber bung and delivery tube	Weighed Mg ribbon & chippings for comparison
2 x large beaker	Thermometer
Water bath	Bunsen burner
Pipette and pipette filler	Stopwatch
2 x clam stand	Graph paper
1x test tube holder	

Method

Before starting each experiment ensure that the HCl test tubes are ready and prepared to be used in each experiment, this ensures that they are all at the same starting temperature and ready for each reaction. The first experiment requires HCl at 0.5, 1, 1.5, and 2 mol. The second experiment requires 2 x 1 mol HCl and the third experiment requires 2 x 1 mol HCl.

1. Concentration on reaction

Prepare 4 x solutions of HCl with different molarity and add each to a different test tube.

Note the temperature of each and ensure they are all the same before taking note in these reactions.

Pour the first and lowest concentration solution into the test tube with the arm.

Add a strip of magnesium and quickly add the bung to the top of the test tube.

Start the stopwatch and note down at specific time periods the volume of gas produced.

Repeat this process for each of the other molarity of HCl and compare the results.

2. Effect of temperature on Speed of reaction

Set up a water bath and heat up a test tube of HCl in the water bath till it has heated up to your chosen temperature.

Add the HCl into the test tube on the clamp and quickly add the magnesium and the bung.

Record the rate of the hydrogen produced.

Repeat this step for an additional temperature at least ten degrees higher than the first and record the results.

3. The effect of surface area on rate of reaction.

Use the pre weighed ribbon and chippings of Mg for this experiment. These weights must be the same.

Ensure the test tubes of HCl are at the same temperature.

Add one of the HCl test tubes into the test tube with the clamp, add the weighed magnesium ribbon and quickly add the bung.

Note the times and volume of hydrogen produced by this reaction.

Repeat this process but using the Mg chips.

Ensure all reaction mixtures are discarded in a waste beaker for ALL experiments.

PPE must be worn at all times.

Lab coat, disposable gloves, and goggles.

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GRADEMARK REPORT

FINAL GRADE

40/100

GENERAL COMMENTS

Engagement with Literature Skills 7/15

Four relevant sources are cited, but none support the core theory (e.g. collision theory, rate laws). References are limited to the discussion/OME section. In-text citation is inconsistent, and IEEE format is only partially followed.

Feedback: Use literature to support theoretical content and apply IEEE formatting correctly and consistently.

Knowledge and Understanding Skills 9/20

The aim is vague, hypotheses lack theoretical justification, and the chemical equation is missing. Variables are partly defined, but control variables are not mentioned. Collision theory is not discussed, and molarity is frequently miswritten.

Feedback: Clarify your aim and hypotheses, include the balanced equation, define all variables, and explain theory with correct terminology.

Cognitive and Intellectual Skills 10/25

No rate calculations are made, and trends are interpreted only visually. Temperature values are unrealistic. Discussion lacks theoretical depth and accurate data analysis.

Feedback: Support trends with calculations, interpret graphs accurately, and use theory to explain anomalies and patterns.

Practical Application Skills 7/25

No rates or methods of calculation are shown. Graphs are incorrect or mislabelled, and units are inconsistently applied. Heating acid to 95 °C outside a fume hood breaches safety protocol. Graph axes are mislabelled.

Feedback: Show all rate calculations, ensure graphs are accurate and labelled, and follow proper lab safety procedures.

Transferable/Professional Skills 7/15

The report is well structured, but contains vague language, unit errors, and inconsistent labelling. Tone is mostly formal, but proofreading is needed.

Feedback: Maintain structure, but improve clarity, terminology, and consistency in language, figures, and labels.

PAGE 1

PAGE 2

PAGE 3



Comment 1

it is a not correct statement. catalyst acts in very different way than the change in concentration or temperature

Strikethrough.

Text Comment. very good explanation

Text Comment. would be very good if you wrote the balanced chemical equation

Text Comment. what are the control variables?

PAGE 4



Comment 3

this is not clear title

Text Comment. unit of molarity is M=mol/L, not mol

PAGE 5

Text Comment. you can remove the title from the graph if you give the same title to the figure

Text Comment. axis y?

Text Comment. axis x ?

Text Comment. this is wrong plot for this experiment!

Text Comment. the blue line is incorrect

Text Comment. these are not correct temperatures. the reactio completes in less than 5 sec at 55 degC

PAGE 6

Text Comment. g

Text Comment. g

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PAGE 7

Text Comment. formula of hydrogen gas is H subscript 2

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Text Comment. catalyst decreases activation energy; increased concentration facilitates successful collisions between the molecules/ions; these are two different processes!

PAGE 8

PAGE 9

PAGE 10
