# Effect of catalyst and surface area on reaction rate

Posted by Anonymous on Fri, 2016-09-23 09:27

Effect of catalyst and surface area on reaction rate: One of my teachers is doing the above mentioned prac for Yr 11 Chemistry. She has asked for saturated Oxalic acid solution. We don't have this so can you please let me know what else she can use instead. The prac can be found in Prelim Course CD Work Sheet 14 Module 4.

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Laboratory Technicians

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# Effect of catalyst and surface area on reaction rate

Submitted by sat on 03 October 2016

Answer reviewed 20 February 2023

A catalyst is a substance that increases the rate of a chemical reaction without itself undergoing any permanent change. It is not consumed in the reaction.

## Reaction between acidified potassium permanganate and oxalic acid

The reaction between acidified potassium permanganate and oxalic acid is a common redox

reaction used to explain the effect of catalyst on the rate of reaction. During the reaction the purple pink potassium permanganate solution ($MnO_4^-$) is reduced to a colourless solution of manganese ions ($Mn^{2+}$). The catalyst used for this reaction is usually a few crystals of manganese (II) sulfate.

A substitute for commercial oxalic acid

- **Rhubarb** contains oxalic acid. Fresh or frozen rhubarb sticks can be used. Here is a link to a method to extract the oxalic acid, as well as some alternative activities considering the effect of surface area and/or concentration on the rate of reaction: Rates and rhubarb [1].
- You will need to trial the concentration of the oxalic acid to be used in your activity.

Note: This reaction is not as straight forward as it may appear, because of competing reactions taking place. The reaction product also acts as a catalyst for the reaction, thereby speeding up the reaction further. This is a process known as autocatalysis.[1,2]

## Alternative catalyst reaction: The decomposition of hydrogen peroxide

When **manganese dioxide** is added to a **hydrogen peroxide** solution (in water) it catalyses the breakdown of the **hydrogen peroxide** into water and oxygen gas.

$MnO_2 + 2H_2O_2$ à $MnO_2 + 2H_2O + O_2$

The $MnO_2$ acts as a catalyst here. It is chemically unchanged during the course of the reaction. That is why it shows up on both sides of the equation. The hydrogen peroxide is broken down into water (which simply goes into the solution) and gaseous molecular oxygen which bubbles out of solution and into the air.

Hydrogen peroxide is unstable and will slowly decompose over time into oxygen and water. The $MnO_2$ acts as a catalyst to make the reaction occur more rapidly.

### Procedure:

- Place 20mL 6% hydrogen peroxide[3] into each of two 100mL beakers. Is there any evidence of a reaction?
- Into one of the beakers add a few grains (or pellets) of manganese dioxide[4] and record your observations.

### Safety notes:

- Add only a few grains of manganese dioxide to the hydrogen peroxide solution otherwise the reaction will be too vigorous. As an alternative use a couple of manganese dioxide pellets.[5]
- Avoid contact with hydrogen peroxide, it can cause burns if it comes in contact with your skin
- Suitable PPE such as laboratory coat, closed in shoes and safety glasses should be

worn at all times

## References

[1] Royal Society for Chemistry, (2016), '*Rates and rhubarb*', Retrieved from the Royal Society for Chemistry website, https://edu.rsc.org/lcredir/learn-chemistry/resource/res00000745/rates-and-rhubarb?cmpid=CMP00005903

[2] Polymer properties database, (nd), *Autocatalytic reactions,* Retrieved (20 February 2023) from the Polymer properties database website: https://www.sciencedaily.com/terms/autocatalysis.htm

[3] Chem-Supply. (2020) *Hydrogen peroxide 6%*, Safety Data Sheet. Search https://shop.chemsupply.com.au/ to source the latest Safety Data Sheet via the product information page.

[4] Chem-Supply. (2021). *Manganese dioxide* Safety Data Sheet. Search https://shop.chemsupply.com.au/ to source the latest Safety Data Sheet via the product information page.

[5] LABNETWEST, (2016, October). *Manganese dioxide,* Retrieved from the LABNETWEST website: http://www.labnetwest.asn.au/manganese-dioxide/

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