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DI TORINO**

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V PRAZE**

Project B: HYDROGENOLYSIS OF ESTERS TO ALCOHOLS

PRODUCTION OF HEXANE-1,6-DIOL AS AN ADDITIVE FOR A DRILLING FLUID

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Introduction:



Fluid Drilling fluids, also called drilling mud, are added to the wellbore to facilitate the drilling process by regulating the formation pressures and supporting well control. The main role is whole cleaning by the removal of cuttings from the bottom of the well and their transportation up to surface. Protection and stabilization of borehole walls is another function of a drilling fluid as well as cooling and lubrication of bit and drill string. On the other hand it brings some problems, as a mechanical reduction of drill string and casing weight, fatigue and enhance the corrosion. Drilling muds are usually based on water or oil (1).

Many problems can occur due to the control loss while drilling and the drilling fluid can be responsible for such problems leading to a blowout. Blowout is the most dangerous problem while drilling due to the catastrophic oil or gas fire that can occur due to the uncontrolled release of oil or gas from a well (1-2). Therefore, it is important to enhance the stability of the well while drilling. Since this stability may increase the safety for the engineers working on the field and also help to decrease the high economic loss of the company. In this case additives are used to enhance the properties of the drilling fluid and well cementing to provide specific characteristics to improve many issues surrounding drilling and avoid the risk of blowout (2).

To get hydrocarbons such as oil and gas, boreholes or wellbores are penetrated by turning a bore bit joined to the foot of a penetrate string. Amid boring, a boring liquid is provided beneath weight into the penetrate string. The boring liquid passes through the penetrating get together and after that releases at the penetrate bit foot. The boring liquid gives oil to the penetrate bit and carries the cuttings of shake and soil delivered by the bore bit in penetrating the wellbore to the surface. Regularly, the costs related with penetrating the wellbore can be significant. Hence, administrators may utilize measures to upgrade angles such as the quality of the wellbore bored, the lessening in wear and tear on boring hardware, and time required to bore the wellbore. A few such measures include the utilize of added substances that control or shift one or more viewpoints of the downhole environment. These added substances may be conveyed into the wellbore alongside the penetrating fluid. **VACUUM FEED SUPPLY SYSTEM** Inventors: William M. Dye (Cypress, TX), Nels A. Hansen (Spring, TX), John B. Trenergy, JR. (Sugar Land, TX OR DRILLING FLUID ADDITIVES



Water-based drilling mud most commonly consists of bentonite clay (gel) with additives such as barium sulfate (barite), calcium carbonate (chalk) or hematite. Various thickeners are used to influence the viscosity of the fluid, e.g. xanthan gum, guar gum, glycol, carboxymethylcellulose, polyanionic cellulose (PAC), or starch. In turn, deflocculants are used to reduce viscosity of clay-based muds; anionic polyelectrolytes (e.g. acrylates, polyphosphates, lignosulfonates (Lig) or tannic acid derivatives such as Quebracho) are frequently used.

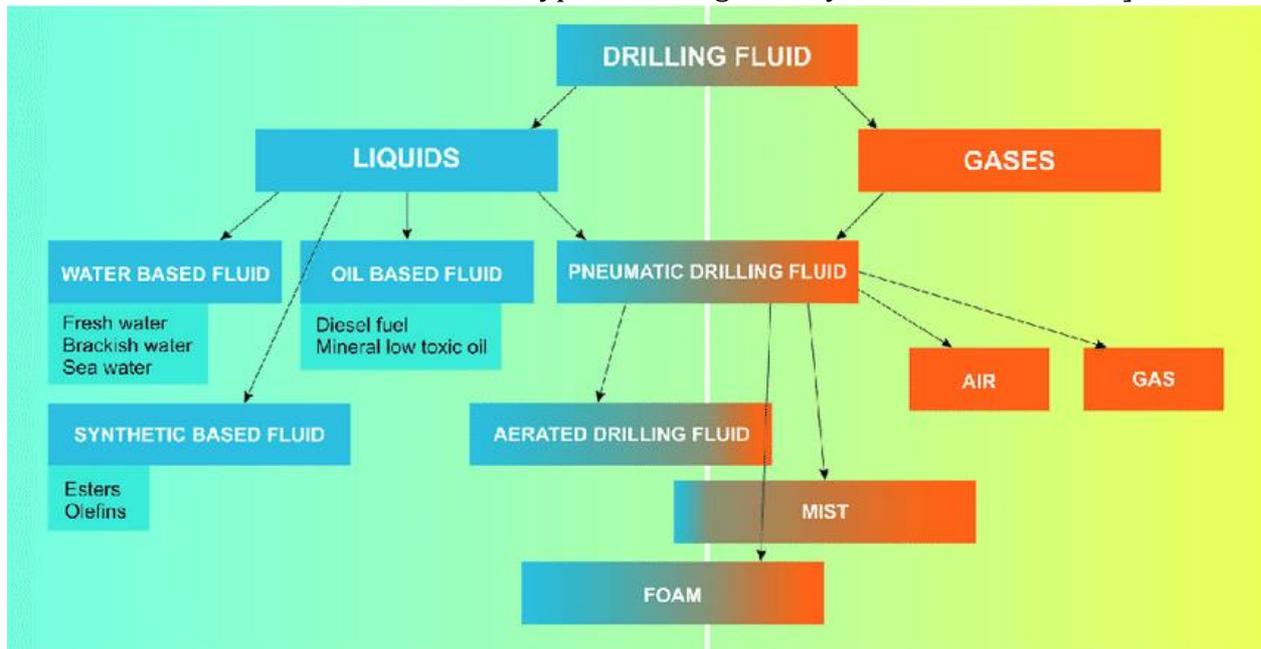
Red mud was the name for a Quebracho-based mixture, named after the color of the red tannic acid salts; it was commonly used in the 1940s to 1950s, then was made obsolete when lignosulfonates became available. Other components are added to provide various specific functional characteristics as listed above.

A weighting agent such as barite is added to increase the overall density of the drilling fluid so that sufficient bottom hole pressure can be maintained thereby preventing an unwanted (and often dangerous) influx of formation fluids. Also, use of silica and clay nanoparticles for high pressure high temperature (HPHT) invert emulsion based muds, and observed their positive effect on the rheology of the drilling mud.

▲ Cheraghian, Goshtasp; Wu, Qinglin; Mostofi, Masood; Li, Mei-Chun; Afrand, Masoud; S.Sangwai, Jitendra (October 2018). "Effect of a novel clay/silica nanocomposite on water-based drilling fluids: Improvements in rheological and filtration properties". *Colloids and Surfaces A: Physicochemical and Engineering Aspects*. **555**: 339–350. doi:[10.1016/j.colsurfa.2018.06.072](https://doi.org/10.1016/j.colsurfa.2018.06.072).

Many types of drilling fluids are used on a day-to-day basis. Some wells require that different types be used at different parts in the hole, or that some types be used in

combination with others. The various types of fluid generally fall into a few broad]



Air: Compressed air is pumped either down the bore hole's annular space or down the drill string itself.

Air/water: The same as above, with water added to increase viscosity, flush the hole, provide more cooling, and/or to control dust.

Air/polymer: A specially formulated chemical, most often referred to as a type of polymer, is added to the water & air mixture to create specific conditions. A foaming agent is a good example of a polymer.

Water: Water by itself is sometimes used. In offshore drilling sea water is typically used while drilling the top section of the hole.

Water-based mud (WBM): Most basic water-based mud systems begin with water, then clays and other chemicals are incorporated into the water to create a homogeneous blend resembling something between chocolate milk and a malt (depending on viscosity).

Oil-based mud (OBM): Oil-based mud is a mud where the base fluid is a petroleum product such as diesel fuel. Oil-based muds are used for many reasons, including increased lubricity, enhanced shale inhibition, and greater cleaning abilities with less viscosity. Oil-based muds also withstand greater heat without breaking down. The use of oil-based muds has special considerations, including cost, environmental considerations such as disposal of cuttings in an appropriate place, and the exploratory disadvantages of using oil-based mud, especially in wildcat wells.

Synthetic-based fluid (SBM) Synthetic-based fluid is a mud where the base fluid is a synthetic oil. This is most often used on offshore rigs because it has the properties of an oil-based mud, but the toxicity of the fluid fumes are much less than an oil-based fluid. This is important when men work with the fluid in an enclosed space such as an offshore drilling rig. Synthetic-based fluid poses the same environmental and analysis problems as oil-based fluid.

[^] Cheraghian, Goshtasp; Wu, Qinglin; Mostofi, Masood; Li, Mei-Chun; Afrand, Masoud; S.Sangwai, Jitendra (October 2018). "Effect of a novel clay/silica nanocomposite on water-based drilling fluids: Improvements in rheological and filtration properties". *Colloids and Surfaces A: Physicochemical and Engineering Aspects*. 555: 339–350. doi:10.1016/j.colsurfa.2018.06.072

Water-based drilling fluids consist of a mixture of solids, liquids, and chemicals, with water being the continuous phase. Solids may be active or inactive. The active (hydrophilic) solids such as hydratable clays react with the water phase, dissolving chemicals and making the mud viscous. The inert (hydrophobic) solids such as sand and shale do not react with the water and chemicals to any significant degree. Basically, the inert solids, which vary in specific gravity, make it difficult to analyze and control the solids in the drilling fluid (i.e., inert solids produce undesirable effects).

Broad classes of water-based drilling-fluid additives are in use today. Clays, polymers, weighting agents, fluidloss-control additives, dispersants or thinners, inorganic chemicals, lost-circulation materials, and surfactants are the most common types of additives used in water-based muds.

Additives have different categories (2):

1. Weighting agents: Such as shales or any substances that are more dense than water and used to enhance the fluid density avoiding uncontrolled problems.

2. Viscosifiers: Such as bentonite or attapulgius that are used to avoid the overcome loss of circulation and to increase the capacity of hole cleaning.

3. Filtration control materials: Such as polymers that are used to decrease the fluid loss and a pressure difference between the hydrostatic pressure and formation pressure.

Viscosifier

The viscosifier can be included specifically to the boring liquid within the wellbore, or blended with the penetrating liquid or other carrier liquids outside of the wellbore, and after that included to the wellbore. Such an expansion can be made using procedures well known to those having aptitude within the craftsmanship, for illustration, by pumping, forcing or manual expansion. The epoxidized greasy corrosive esters utilized as the viscosifier are as portrayed above. In still another exemplification, the current development relates to a prepare comprising boring a wellbore in a underground arrangement wherein a boring liquid is included to the wellbore, the boring liquid comprising 0.1 to 50% by weight of at slightest one viscosifier chosen from epoxidized

greasy corrosive esters, wherein the greasy corrosive of the greasy corrosive ester is determined from normal oils or creature fats, and the greasy corrosive is considerably completely esterified with monohydric or polyhydric alcohols or blends thereof.

A viscosifier in well penetrating and workover strategies is appeared which comprises an successful sum of a montan wax scattered inside the liquid to supply the required thickness and gel quality to properly suspend solids within the penetrating liquid. Montan wax is scattered in an oil base which contains as small as almost 5 volume percent water. A fundamental fabric, such as lime, responds within the water with the montan wax, and the fractional saponification which comes about produces a thixotropic boring liquid. (

Assignee: Hughes Tool Company (Houston, TX) Inventor: Horst K. F. Barthel (Suessen)

weighting

In oil boring applications, weighting specialists may be utilized in oilfield penetrating and cementing liquids to raise the liquid thickness. Fluid boring liquid is regularly alluded to as penetrating mud. The three fundamental sorts of penetrating liquids are water-based muds (which can be scattered and non-dispersed), non-aqueous muds, ordinarily called oil-based muds, and vaporous penetrating liquids. The penetrating liquids work to supply hydrostatic weight to avoid underground liquids (e.g., gas, water, and/or oil) from entering the wellbore, to avoid collapse of the wellbore, to keep the penetrate bit cool and clean amid penetrating, to carry out penetrate cuttings, and to suspend the bore cuttings whereas penetrating is ceased. After penetrating, a tubular steel casing is regularly brought down into the wellbore, and a cementing liquid is pumped down the center of the casing and up into the annular space between the casing and the wellbore. The cementing liquid at that point sets into a solid, impermeable strong which holds the casing in put and seals the annular space, in this way anticipating entry of liquids along the wellbore on the exterior of the casing.

FERROSILICON WEIGHTING AGENTS FOR WELLBORE FLUIDS, applicant: Imerys Oilfield Minerals, Inc. (Roswell, GA)

Inventors: Thomas Parias (Rhodes Sint Genesius), Jonathan Stuart Phipps (Cornwall), Jarrod Hart (Cornwall), Mark Windebank (Cornwall), Christopher Bean (Los Alamos, CA)

filtration control

The show development relates to a filtration control added substance for utilize in rearrange emulsion boring liquids; the strategy of planning such added substances; the alter emulsion penetrating liquid delivered subsequently; and a strategy of penetrating, completing, and working over a underground well, utilizing such boring liquid containing the filtration control added substance which is utilized in a water-in-oil, emulsion-type underground boring liquid. The added substance comprises the pyrolyzed item gotten by intermixing and warming a finely isolated humic acid-containing fabric and a essential amine having an alkyl radical of 10 to 20 carbon iotas or a essential amine having one alkyl-substituted phenyl radical, the alkyl radical having 10 to 20 carbon iotas. The amine may too be a auxiliary amine having at slightest one alkyl radical of 8 to 20 carbon molecules. **Filtration control additive for invert emulsion drilling fluids and method of preparation**

Assignee: Milchem Incorporated (Houston, TX) Inventors: Dennis K. Clapper (Houston, TX), Darrell P. Salisbury (Sugarland, TX)

Hydrogenolysis:

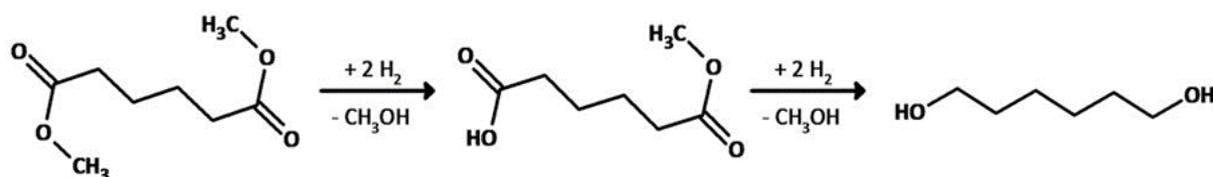


Figure 1: Hydrogenolysis of dimethyl adipate

On the other hand, generation of glycerol utilized as the polyhydric liquor in nourishment or restorative applications has been expanded year by year. One of the reasons therefor is the spread of bio-diesel fills which have as of late come to overwhelm owing to questionable supply of fossil powers or worldwide warming issues. Glycerol is created amid the method for generation of the bio-diesel fills from crude vegetable materials.

In any case, over the top supply of the glycerol has happened due to right now constrained applications thereof. Utilization of the glycerol has been requested. As one arrangement of the over issue, a catalytic response of the glycerol for changing over the glycerol into C3 alcohols has been taken note over the world. The C3 alcohols are valuable as different mechanical materials, etc. Among the C3 alcohols, as diols, there are 1,3-propanediol and 1,2-propanediol. The 1,3-propanediol has been taken note as a crude fabric of polyesters and polyurethanes, etc. On the other hand, the 1,2-propanediol has been utilized, for case, for generation of polyester gums, paints, alkyd gums, different plasticizers, anti-freezing liquids, brake oils, etc., and advance are valuable for generation of nourishment wetting operators, consistency increasers for natural product juices, cellophane conditioners for nourishment, makeup, drugs, etc. In the circumstances, in arrange to successfully utilize glycerol, it has been considered to change over glycerol into propanediols, and there are in this manner known different strategies for creating 1,2-propanediol (hereinafter once in a while alluded to simply as "1,2-PD") by hydrogenolysis of the glycerol. **METHOD FOR PRODUCING HYDROGENOLYSIS PRODUCT OF POLYHYDRIC ALCOHOL** Inventors: Nobuyoshi Suzuki (Wakayama), Masazumi Tamura (Wakayama), Taku Mimura (Wakayama).

Hydrogenolysis of polyhydric alcohols gotten from the common world employing a catalyst for changing over the polyhydric alcohols into other compounds is an imperative procedure from the perspective of viable utilization of materials or substances. On the other hand, generation of glycerol utilized as the polyhydric liquor in nourishment or therapeutic applications has been expanded year by year. One of the

reasons therefor is the spread of bio-diesel fills which have as of late come to overwhelm owing to questionable supply of fossil fills or worldwide warming issues. Glycerol is delivered amid the method for generation of the bio-diesel fills from crude vegetable materials. In any case, over the top supply of the glycerol has happened due to right now restricted applications thereof. Subsequently, compelling utilization of the glycerol has been requested.

As one arrangement of the over issue, a catalytic response of the glycerol for changing over the glycerol into C3 alcohols has been taken note over.

Method for producing hydrogenolysis product of polyhydric alcohol

Nobuyoshi Suzuki (Wakayama), Masazumi Tamura (Wakayama), Taku Mimura (Wakayama)

Hydrogenolysis of biomass-derived glycerol is an elective course to attainable era of propylene glycol. Cu-ZnO catalysts were orchestrated by coprecipitation with a run of Cu/Zn atomic extent (0.6-2.0) and reviewed in glycerol hydrogenolysis to propylene glycol at 453-513 K and 4.2 MPa H₂. These catalysts have destructive and hydrogenation districts required for bifunctional glycerol reaction pathways, most likely counting glycerol drying out to acetol and glycidol intermediates on acidic ZnO surfaces, and their following hydrogenation on Cu surfaces. Particular hydrogenolysis of glycerol to propylene glycol on Cu-ZnO catalysts

Hydrogenolysis reaction is used to convert esters to alcohols. This process requires the cleavage of C-O single bonds by H₂ without any interference in C-C bonds (4-5). For this purpose, a number of solid catalysts were tested. Cu-Cr catalyst that is called Adkins catalyst is the most active. The role of Cr is to increase the dispersion of Cu particles on the surface and to prevent active sites from sintering (4-5). During the preparation of Adkins catalysts some toxic waste is obtained. It can be released into the environment causing pollution and affecting human health (6-7).

Due to the strong environmental restrictions different catalysts are tested, such as CuO, ZnO, Cu-Zn, RuSn/TiO₂, RuSn/Al₂O₃, Cu-Zn-Zr, Cu-Zn/Al₂O₃, and Pt/Al₂O₃ (3-8).

Hypothesis: The aim of this project is to test different types of catalysts such as CuO, ZnO and Cu/Zn ratio 0.5 in the conversion of DMA to the production of hexane-1,6-diol.

Catalysts such as CuO, ZnO, and Cu-Zn were chosen due to the multi benefits provided by copper that has a high conversion performance in hydrogenolysis reaction. Because the catalyst containing only copper is not mechanically stable, the copper-based catalyst is combined with zinc. Where zinc helps to prevent sintering and provides better dispersion of copper particles (9-10). These considerations enhanced the replacement of Cr by Zn as a more ecological catalyst.

Aqueous solutions of glycerol were hydrogenolysed at 180 °C under 80 bar H₂-pressure in the presence of supported metal catalysts in an attempt to selectively produce 1,2- and 1,3-propanediol. Catalysts (Cu, Pd, Rh), supports (ZnO, C, Al₂O₃), solvents (H₂O, sulfolane, dioxane) and additives (H₂WO₄) were tested to improve reaction rate and selectivity to the target molecules. The best selectivity (100%) to 1,2-propanediol was obtained by hydrogenolysis of water solution of glycerol in the presence of CuO/ZnO catalysts.

Glycerol hydrogenolysis on heterogeneous catalysts

Julien Chaminand,^a Laurent Djakovitch,^{*a} Pierre Gallezot,^a Philippe Marion,^b Catherine Pinel^{*a} and Cécile Rosier^b

Whereas Cu–Zn oxide (signified as Cu–ZnO) catalysts were arranged by coprecipitation of watery arrangements of Cu(NO₃)₂ • 3H₂O and Zn(NO₃)₂ • 6H₂O with urea (All from Beijing Chemicals, AR review) [10,11].

The concentrations of Cu²⁺ and Zn²⁺ within the arrangements were shifted to alter the Cu/Zn nuclear proportion by keeping a steady cation (Cu²⁺ + Zn²⁺) concentration of 0.05 M. The concentrations of urea were kept at 0.5 M within the arrangements.

The arrangements were warmed to 363 K and maintained at 363 K for 2 h to make accelerates. The accelerates were matured at 333 K for 2 h, taken after by filtration and completely washing with deionized water until the filtrates were neutral. These accelerates were treated in encompassing discuss at 383 K overnight, and after that at 573 K for 3 hours.

the Cu/Zn nuclear proportions for the resulting three catalysts were 0.6, 1.0, and 2.0. For comparison, bulk ZnO and CuO were moreover arranged within the same way by coprecipitation of a solution.

Selective hydrogenolysis of glycerol to propylene glycol on Cu–ZnO catalysts

Experimental part:

The experimental part is the procedure or the steps where the test was taken. In this case different steps are arranged from the preparation of the catalyst as a first step to the end of the test as conversion and selectivity are obtained.

As mentioned this test is carried out to detect the best possible way to have an environmental catalyst rather than cr.

Cr or chromium catalyst as several tests detected the presence for the polluted results, after conversion. Due to that, the research aim as to find a friendlier catalyst that can also have a high conversion and selectivity.

The chosen catalyst was Zn, zinc was combined with Cu with different ratios: 0.5, 1, 1.5, and 2.

All these were to insure the ability to replace Cr by Zn. Different results were obtained in this test most of them were satisfied.

The preparation of the different catalyst were the same, depending on a lab work, hand working until the catalyst are added in the fixed-bed reactor.

Catalysts CuO, ZnO and Cu/Zn with a ratio 0.5 were used in hydrogenolysis reaction. The conversion of dimethyl adipate and the selectivity to hexane-1,6-diol showed different results. Different products were also obtained from the hydrogenolysis of dimethyladepate such as:

- 1) Methyl 6-hydroxyhexanoate
- 2) 6-methoxy-6-oxohexyl methyl adipate
- 3) 6-hydroxyhexyl methyl adipate
- 4) 6-hydroxyhexyl 6-hydroxyhexanoate
- 5) Bis (6-methoxy-6-oxohexyl) adipate
- 6) 6-hydroxyhexyl (6-methoxy-6-oxohexyl) adipate
- 7) Bis (6-hydroxyhexyl) adipate

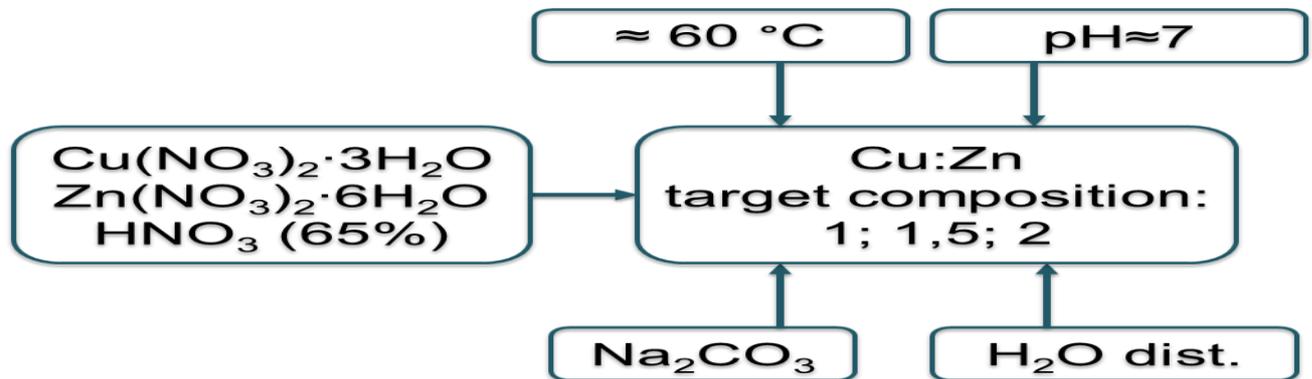


Catalyst preparation:

In this project the different types of catalysts such as CuO, ZnO and Cu/Zn ratio 0.5 in the conversion of DMA to the production of hexane-1,6-diol, were prepared in different stages in order to achieve the specific results needed in this case.

1. Catalyst preparation

Catalysts were prepared by several steps. The first one was preparation of an aqueous solution of copper and zinc nitrates and then HNO₃ was added. Then there followed a preparation of an aqueous solution of Na₂CO₃. The prepared solutions were heated to 60 °C. These solutions were added into a beaker with a distilled water. The flow rate was regulated by changing the pump performance keeping pH constant. The prepared solutions were immediately filtered without any ageing, then washed with distilled water and finally the wet cakes were dried at 110 °C.



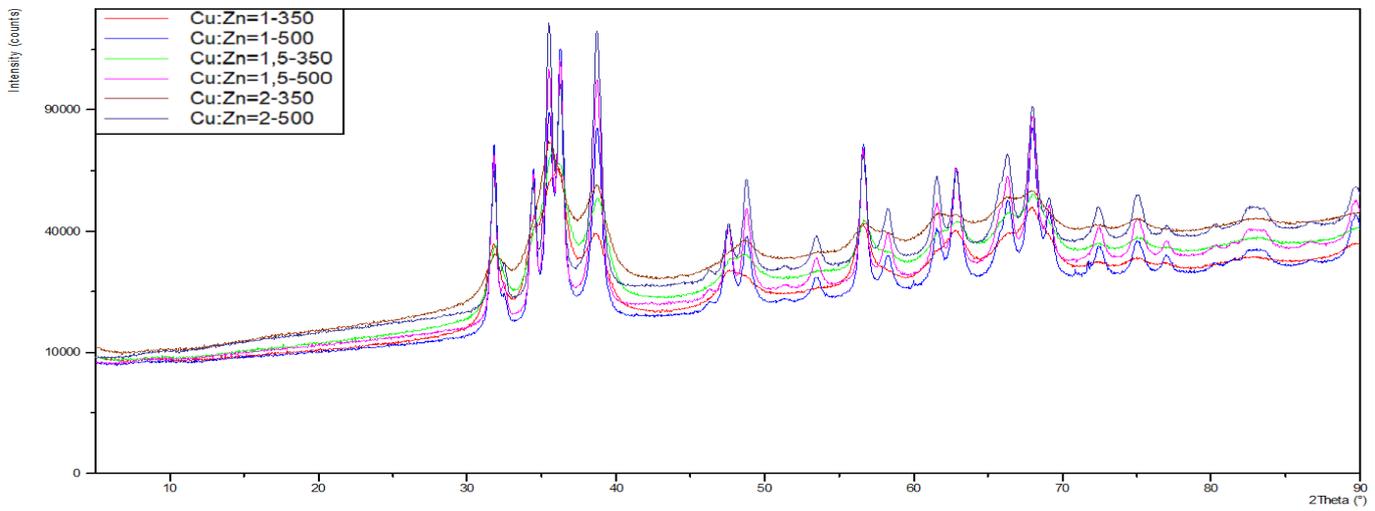
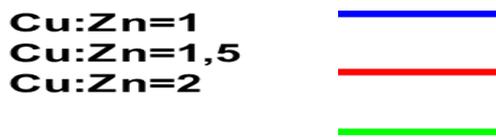
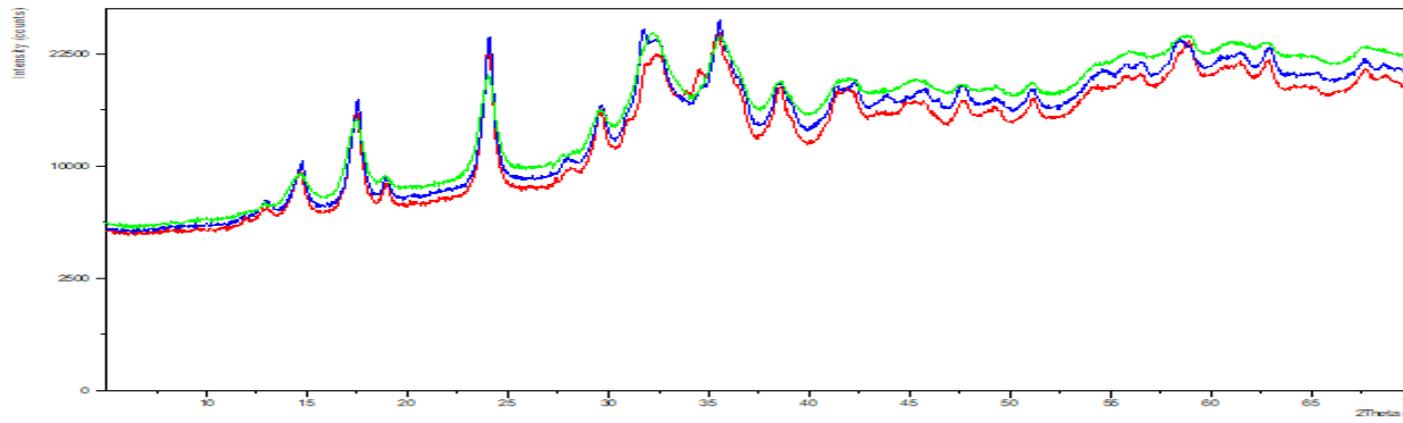
Elemental composition, % XPS, XRF

2. Catalyst characterization

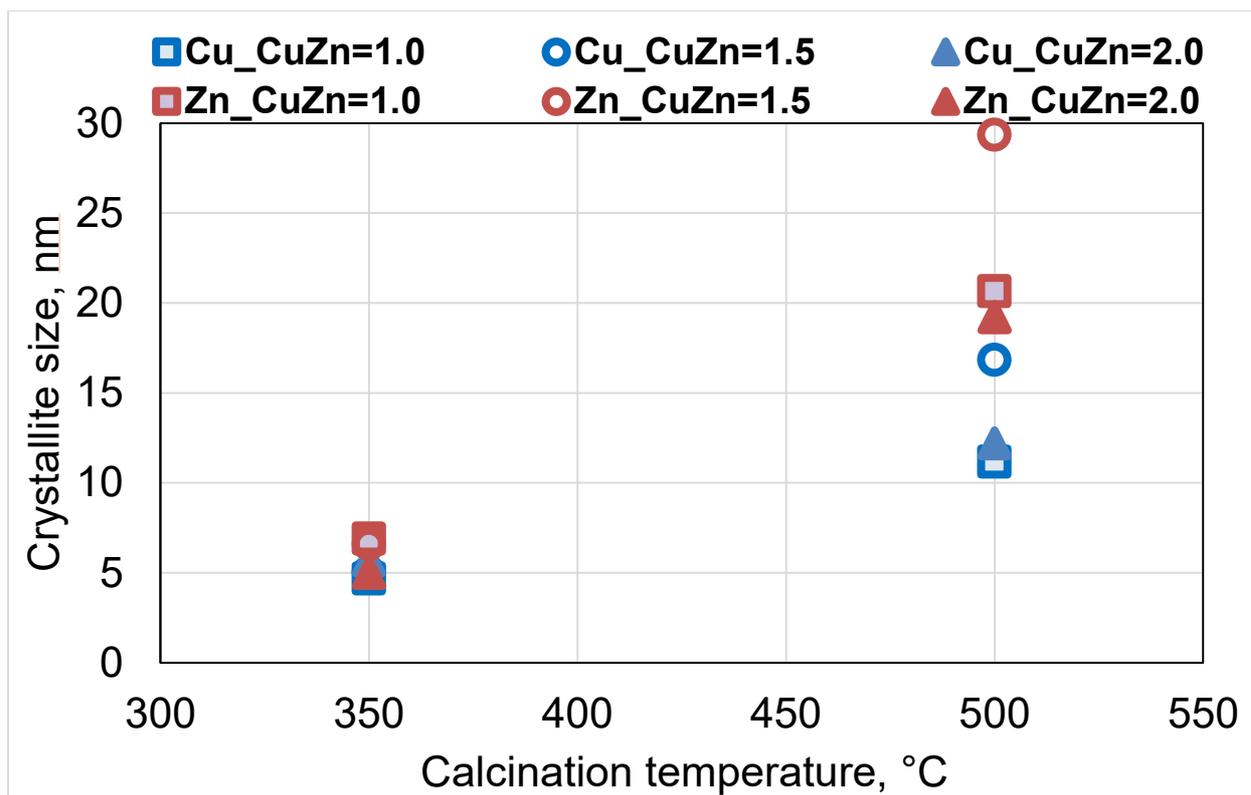
Catalysts were characterized by XRF method to detect the elemental bulk composition. Fresh catalysts were also characterized by X-Ray diffraction to determine the phase composition.

Cu/Zn target ratio	XPS (surface composition)		XRF (bulk composition)	
	Cu	Zn	Cu	Zn
1	14,5	85,5	51,6	48,4
1,5	33,9	66,1	60,7	39,2
2	41,6	58,4	67,6	31,6

Characterization of CuZn cata



Calcination:



After that, the catalysts were calcinated at 350 °C and after calcination they were modified by sieving to 0.10-0.25 mm particle size fraction. The used sieving instrument is shown in Figure 2.



Figure 2: Sieving instrument

3. Catalyst testing

This experiment was carried out in a flow reactor with a fixed catalyst bed. Figure 3 presents the used fixed-bed reactor in a heating oven. This reactor has a length around 16 cm. It can be charged with 5 g of the catalyst between two same silicon carbide layers as an inert matrix.

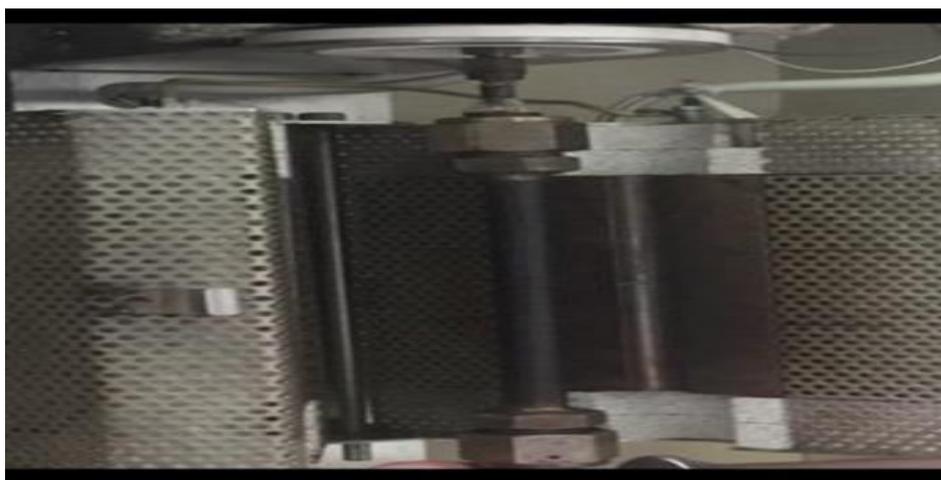


Figure 3: Reactor

After the reactor was filled, a pressure test was done to detect the loss of hydrogen due to any possible leakage.

The catalyst had to be reduced by hydrogen in a nitrogen flow at a temperature of 220 °C. The concentration of hydrogen was increased gradually up to 100% volume of H₂. The quick catalyst reduction was avoided because the fast increase of the temperature can occur. Then the performed experiments were tested at a temperature range of 160–205 °C and the hydrogen pressure of 16 MPa.

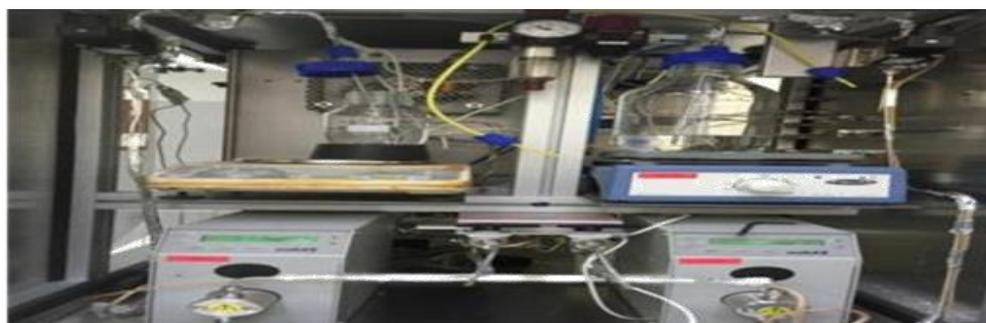


Figure 4: Pumps in the reactor

During the experiment, DMA was pumped in the reactor with 10-20g/h flow rates

This experiment was controlled by PC software done by Vinci Technologies. This software was used to control the experiment conditions such as reaction pressure, temperature and flows of the feed and hydrogen. During the experiment, samples were taken at different temperatures recorded by the software.

4. Product analysis

Different samples were collected at different temperatures in a range of 160-205 °C. The samples were diluted by butanol to decrease its concentration in order to be suitable for gas chromatography method. Gas chromatograph showed in Fig.5.

The area under a gas chromatograph peak was proportional to the amount (moles) of the compound eluted. Therefore, the molar percentage composition of a mixture was approximated by comparing relative peak areas. Then, to calculate the percentage of any compound in the mixture, its individual area was divided by the total area and the result was multiplied by 100.

The composition was obtained for each tested sample. This experiment was made to compare the activity of the catalysts by the conversion of dimethyl adipate and selectivity to hexanediol.

The formulas were used to calculate conversion and selectivity:

$$\text{—————} * 100\%$$

The definition of conversion was the difference of the initial number of moles of dimethyl adipate with the remained number of moles after the reaction over initial number of moles of DMA.

$$\% = \text{—————} * 100\%.$$

The definition of selectivity to a compound was the ratio of the number of moles of a desired product formed to the number of moles of all products.



Figure 5: Gas chromatograph

RESULTS AND DISCUSSION

1. Catalyst characterisation

Table 1: Bulk composition

Catalyst	XRF(bulk composition, Wt.%)	
	CuO	ZnO
CuO	100	--
CuZn0.5	35	65
ZnO	--	100

Catalysts were characterized by XRF to detect the bulk composition. Table 1 showed the weight percentage of the bulk composition of CuO, ZnO and Cu/ZnO with a ratio of 0.5.

Table 2: Phase composition

Catalyst	Phase composition, %	
	CuO	ZnO
CuO	100	--
CuZn0.5	25	75
ZnO	--	100

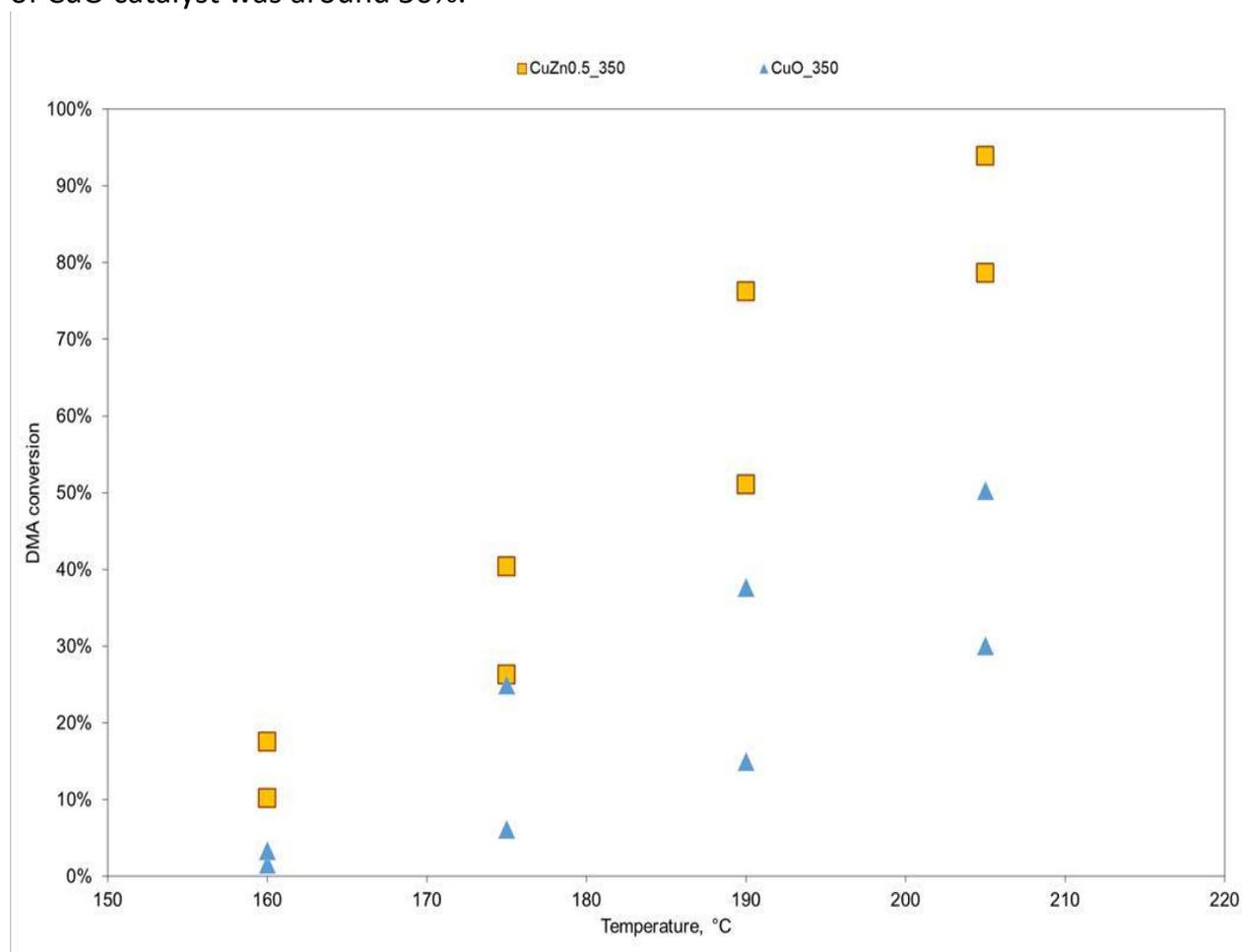
Catalysts were characterized by XRD to detect the phase composition. Table 2 showed the percentage of the phase composition of CuO, ZnO and Cu/ZnO with a ratio of 0.5.

2. Catalytic results

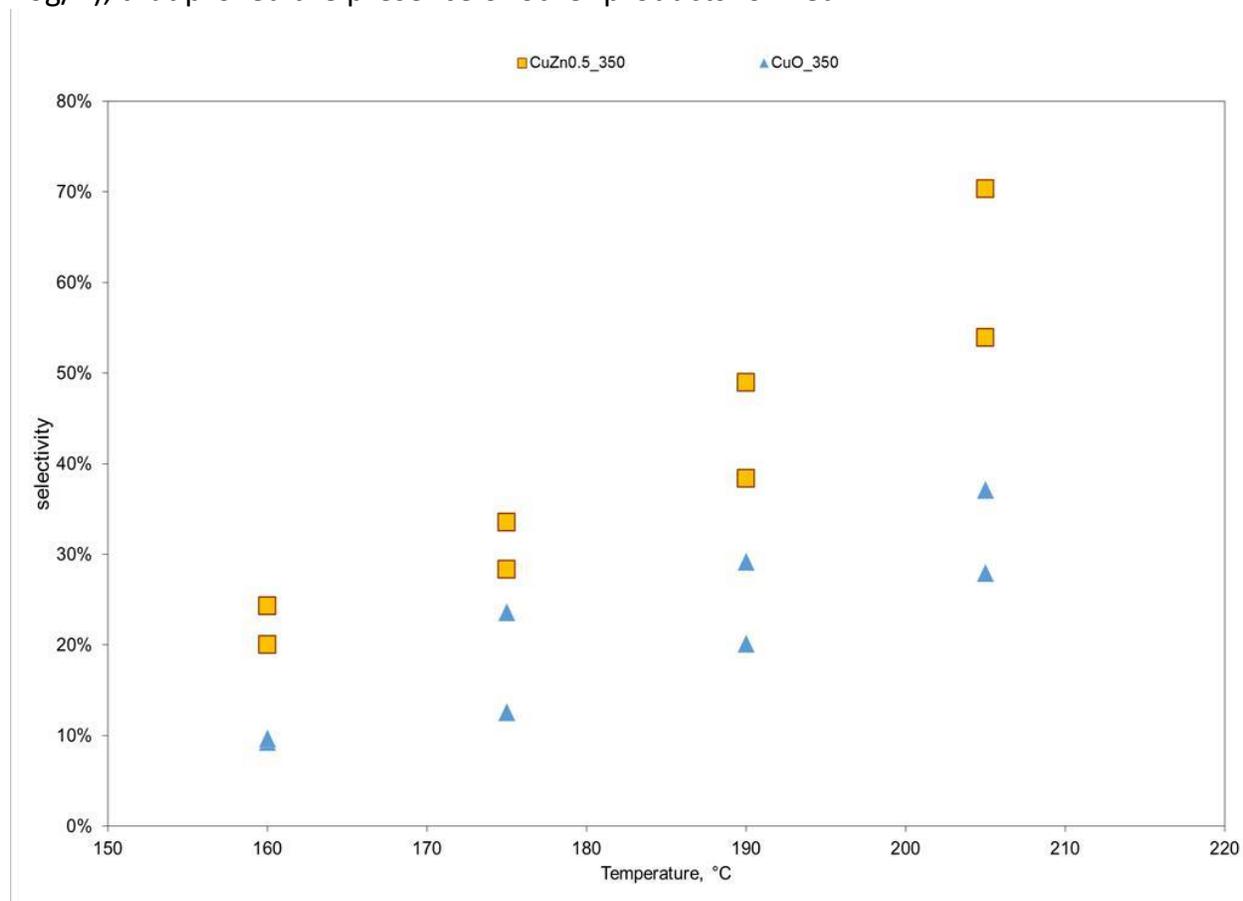
Catalysts CuO, ZnO and Cu/Zn with a ratio 0.5 were used in hydrogenolysis reaction. The conversion of dimethyl adipate and the selectivity to hexane-1,6-diol showed different results. Different products were also obtained from the hydrogenolysis of dimethyl adipate such as:

- 1) Methyl 6-hydroxyhexanoate
- 2) 6-methoxy-6-oxohexyl methyl adipate
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- 5) Bis(6-methoxy-6-oxohexyl) adipate
- 6) 6-hydroxyhexyl (6-methoxy-6-oxohexyl) adipate
- 7) Bis(6-hydroxyhexyl) adipate

In the graphs below two points for every catalyst were obtained and that was due to the different flow rates of DMA for 10g/h and 20g/h. CuZn0.5 catalyst results showed 95% of DMA conversion at 205°C and 10g/h. At the same conditions, the conversion of CuO catalyst was around 50%.



CuZn0.5 catalyst results showed 75% selectivity to hexane-1,6-diol at 205°C and 10g/h. At the same conditions, the selectivity to hexane-1,6-diol of CuO catalyst was around 35%. Since the maximum selectivity to hexane-1,6-diol reached a maximum 75% (205 °C, 10g/h), that proved the presence of other products formed.



Interestingly, the result of ZnO showed a zero conversion. So, ZnO catalyst is not an active catalyst in hydrogenolysis but copper is an active site as the conversion results of DMA showed.

Conclusion

Different types of catalysts were tested such as CuO, ZnO, CuZn0.5. These catalysts were characterized by XRF and XRD methods. ZnO catalyst showed no conversion itself. CuO showed 50% conversion of DMA and 35% selectivity to hexanediol (205 °C, 10 g/h, 16 MPa). While CuZn0.5 ratio showed a higher conversion of 95% and a selectivity of 76% to hexanediol (205 °C, 10 g/h, 16 MPa).

The combination of both CuO and ZnO catalysts in the form of Cu/Zn with a ratio 0.5, showed a high conversion and selectivity and this results proved its efficiency as an active catalyst in the hydrogenolysis rea

