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Concentrated Aqueous Catalyst

From the experimentation and efforts of Paul Gobert of Australia, written by Phillip Hill.

Many bristled at the suggestion to use Concentrated Aqueous Catalyst because it is so contrary to the conventional wisdom of the day. But the idea of using all liquid measures for all ingredients was especially exciting. Keeping water out of the biodiesel equation has been drummed into us from the start because, they warned, it would promote the production of soaps. Paul's experiments show otherwise!

The Advantages

- The traditional method of Methoxide preparation involves dissolving the required amount of alkali in alcohol. The alkali is not readily soluble in the alcohol and vigorous stirring is required to ensure complete solution. This is both time-consuming and dangerous.
- Concentrated aqueous Sodium Hydroxide solution dissolves instantly in methanol producing a clear methoxide. Measuring volumes is more convenient than weighing.
- Expensive scales are not required and small volumes of methoxide for tests can be prepared much more precisely.
- The concentrated aqueous Sodium Hydroxide can be stored indefinitely if protected from atmospheric water and CO2.
- Solid Sodium Hydroxide readily absorbs water from the atmosphere and reacts with carbon dioxide to form sodium carbonate, which is a poor catalyst.
- Sodium carbonate is insoluble in concentrated aqueous Sodium Hydroxide so any contamination of the concentrated solution by CO2 will produce a precipitate, which will sink to the bottom of the bottle.

Why use Concentrated Aqueous Catalyst?

There are those who would ask that question. I asked the very same question.

1. A scale is not needed in order to mix it or to measure it into the alcohol.
2. Using all liquid measurements is easier to deal with.
3. It makes for simpler adaptation to continuous processes.
4. Your catalyst will not "carbonize" and lose its potency, as a dry one will.
5. It mixes with alcohol instantly, saving lots of time on process day.

The Basics

The idea is to make a concentrated solution of the catalyst in distilled or de-ionized water. According to published technical data about pure Sodium Hydroxide 1gram can be dissolved in .9 ml of water at 20C (68F). This makes a final volume of 1.2ml of solution. Taking that a little further 1000grams(1kg) can be dissolved in 900ml of water. This

makes 1200ml(1.2L) of solution. Store the solution at or above 20C, it will solidify at lower temperatures.

Catalyst data

Sodium Hydroxide ***(NaOH)***
99% pure - 1g /.9ml

Potassium Hydroxide ***(KOH)***
(*Commercial grade KOH is normally 83-88% pure*)
99% pure – 1g / .90ml – 1kg in 900ml
90% pure – 1g / .72ml – 1kg in 720ml
88% pure – 1g / .697ml – 1kg in 697ml
86% pure – 1g / .639ml – 1kg in 639ml
83% pure – 1g / .617ml – 1kg in 617ml

How to mix it

BE CAREFUL! Mixing Sodium Hydroxide (or Potassium Hydroxide) in water can generate a LOT of heat! Have cold water nearby to cool your mixture back to 20C.

Mix it in a stainless steel or plastic vessel. Strong alkalis can etch glass.

Again, the idea is to mix as much catalyst as water will hold at 20C(68F).

Start with your water (900ml for Sodium Hydroxide) and begin adding catalyst slowly while stirring continuously, allowing the heat to dissipate as you go. Continue adding catalyst until the prescribed amount (1kg) has been added to the appropriate amount of water or until it begins to precipitate, or fall out of solution again.

Check the final volume of solution at 20C (68F). Divide this number by 1000 to find your liquid measure per gram. If you end up with 1300 ml then, for every gram your batch calls for you will multiply that times 1.3 to get how much of the liquid to use.

How to store it

Store your concentrated aqueous catalyst in plastic “air-tight” containers, like polypropylene or polyethylene that can stand up to alkalis. Don’t use glass stoppers in glass bottles as the glass stoppers will get “cemented” into the neck of the bottle and become useless. Your solution should be able to be stored indefinitely if kept sealed up away from atmospheric moisture and carbon dioxide.

How to use it

This means that 1.2ml of Concentrated Aqueous Catalyst contains 1g of Sodium Hydroxide. So, by multiplying the number of grams your batch needs by 1.2, you get how many milliliters of catalyst solution you need to add to your alcohol to make methoxide.

Simply measure it out and pour it into the appropriate measure of alcohol and stir it up a little. This catalyst mixes instantly in methanol.

Observations

"I am not sure of the mechanism of the conc. aqueous NaOH," says Paul, "but I am sure of the fact that it works very well. Yields for the single stage base method are in accordance with the FFA content. When using the acid/base method on high FFA oils/fats the yield is equivalent to the volume of oil/fat feedstock. Methoxide preparation is much quicker and safer. I use it as my standard method processing a wide range of feedstocks (lightly used vegetable oils, heavily used vegetable oils and heavily used animal fats)".

I too have made many batches using this technique. I have not seen any tendency toward the production of soaps in my batches. The aqueous solution mixes instantly with methanol and minimizes the chance of alcohol evaporation while mixing.

One explanation is that the catalyst occupies or binds with the water and does not allow it to be available for the production of soaps.

Ok, so what about the quality of reclaimed methanol? That is a concern for anyone who recovers methanol for reuse in subsequent batches. Recovery will require a little more heat to strip the methanol away but should not affect the quality of the methanol. Methanol reclamation by vacuum should not be affected much.

Conclusion

After using this method personally and reading the test results from a growing number of experimenters, I must fully endorse it as one that is safe, easy and beneficial in the production of quality biodiesel. It opens up more possibilities in continuous processes and provides a safer method of mixing and handling the catalysts.