Delta 9 Synthesis from CBD using AlCl3

Materials needed:

Glass reactor
Roto vap
Chiller/heater capable of -30C to 120C
Distillation apparatus
Anhydrous AlCl3
DCM
99% Dry Isopropanol
Glacial Acetic Acid
Nitrogen/Argon
Calcium Chloride/4a mol sieves
Activated Carbon
SODIUM BICARBONATE

Note: All chemicals listed should be reagent grade unless otherwise dictated.

Preparing the reaction:

1. DCM is mixed and dried with 10% Calcium chloride for 4 hours. Sieve beads can also be substituted. *DCM that has been dried can then be stored in an airtight/inert container for future use.*

Do not store it with calcium chloride as DCM will become too dry at this point.

2. *CBD NEEDS TO BE DRIED IN AN OVEN AT 120 C FOR AT LEAST TWO HOURS BEFORE USE*

3. CBD is dissolved/homogenized in DCM at a 2:1 ratio of DCM:CBD *Super saturation is best for this procedure IF CBD IS NOT MIXING READILY. By warming up the DCM to 34C we can solubilize the cbd isolate much more efficiently.*

3% aluminum chloride (by weight of CBD) is prepared in an addition funnel. DANGER: if the air is moist it is best to prepare AlCl3 in a small amount of DCM under an inert atmosphere before addition funnel! Alcl3 will react with moisture to give off HCL gas. Toxic and caustic. Please exercise caution.

Assembling the Reactor:

A. CBD:DCM solution is placed inside the reactor and stirred at 450 rpms.

B. Reaction is warmed to 34C and homogenized for 10 minutes. IF NECESSARY, IF CBD MIXES FINE BEGIN CHILLING WHILE MIXING

C. A graduated Addition funnel with the described amount of AlCl3 is added to one of the accessory ports. Keep the valve close until addition is necessary. **Your standard liquid addition funnel will not work here! There is not enough opening for alcl3 to flow through. Please make sure you have a powder addition funnel.**

D. Atmospheric conditions in the reaction are purged using vacuum and then brought back to neutral pressure with nitrogen/argon 3 TIMES

E. Using the GR's chiller, the Chiller is used to bring solution to -5C (if cbd crystallization occurs your DCM is not dry enough) DCM should not be completely dry as the reaction will go nowhere. If above occurs add 30 minute increments to the drying process. Please wait until internal temperature stabilizes at -5C

AlCl3 is added **SLOWLY**, observing volatility. There will be a slight exothermic reaction. This is fine but important to keep the reaction chilled. IF TEMPERATURE JUMPS MORE THAN 5C ALLOW THE REACTION TO CHILL BACK TO -5 BEFORE ADDING ADDITIONAL ALCL3

Reaction is stirred for 30 minutes. At this point the reaction should be complete.

Quenching the reaction: ***Isopropanol addition -5C***

a. FOR EVERY 15KG CBD ISOLATE SIZED REACTION. 1:2 ratio ISO:DCM
b. Nitrogen is applied the entire time bubbling through the reaction mixture and evacuated via vacuum or exhaust valve **DO NOT RELEASE GASSES INTO THE OPEN ATMOSPHERE**
c. Add your isopropanol to the addition funnel.
d. Slowly add isopropanol to the reaction mixture examining volatility. Stirring the entire time. (reaction is slightly exothermic)
e. Keep a bag of sand near the reaction chamber. If reaction begins to run away dump the sand into the reaction.
f. Once all Isopropanol has been added stir rapidly for 15 minutes.
g. Add acetic acid at a 3:1 ratio Acetic Acid: Aluminum Chloride used to react.
h. Stir rapidly for 20 minutes. This will create Aluminum Acetate.

See notes:

If pressure builds lightly use vacuum regulator to exhaust. Do not release pressure into open atmosphere unless under fume hood. Proceed to water washing.

LLE washing procedures:
Converted solution is washed with 15 liters or a 5 gallon bucket unless otherwise dictated.

Wash 1: 7% Sodium Bicarbonate water. Mix for 15 minutes and then warm to room temperature and mix for 15 minutes more. Allow to separate and discharge aqueous.

Wash 2: saturated brine water. (water should be warmed to 98F and allowed to accept as much water as possible. When the saturation point has been completed you will notice the water begins to reject the salt. Mix vigorously and allow to separate/discharge aqueous.
Wash 3: saturated brine water. Mix vigorously and allow to separate/discharge aqueous.
Wash 4: 1% by weight Citric Acid:water, mix vigorously and allow to separate/discharge aqueous.

<u>Wash 5</u>: 5% by weight sodium hydroxide:water mix vigorously and allow to separate/discharge aqueous.

Then proceed to follow the above procedure with as many distilled water washes as necessary to produce a PH neutral solution. 6-7 PH

Notes: *All % calculations for water washes are determined by water concentration. Ex: 7% Sodium Bicarb wash = 5 gallon bucket of water + 1,324 grams of sodium bicarbonate. Water wash should always be equal to or greater than the volumetric equivalent of DCM/CBD*

Drying:
Add 20% by weight of CBD Calcium chloride to reaction mixture. Stir rapidly for 30 minutes. Discharge solute into a container suitable for transport and move to filtration.

Removing any other unwanted compounds to prevent isomerization during distillation:
We will want to assemble a filtration apparatus. This can be done on many varying degrees of scale but the

most important to note here is ensuring that we are using 10% activated charcoal per weight of CBD. For example 15kg of newly isomerized cbd in DCM will need approximately 1.5 kg of activated charcoal. You will want to vacuum filter your isomerized CBD in solvent through the activated charcoal. This will create a sludge like substance from any remaining alc13 that was not discharged during the reaction. This may fizzle a little bit and is good lab practice if procedure is carried out under adequate ventilation. Before filtering make sure to wet your AC with DCM. A small amount will go a long way.

1. Add 1.5 kg of Activate Carbon over 2.5-5 micron filter into the filtration apparatus.
2. Wet or “seat” the pad with a small amount of DCM.
3. Filter your converted oil solution over the AC with a slight vacuum.

Solvent recovery: **It is imperative to ensure that solvent recovery is at 99.99% Any residual DCM carried over from the reaction to distillation will result in an astronomical increase in d8. Almost 50% is observed. You can test this by testing your**

crude oil first before distillation. If your crude oil is 90+% D9 and your distillate is contaminated with delta 8 the issue is solvent carried over into the distillation process, OR the oil was not completely dried. If the rotovap is incapable of 99% solvent recovery then you may collect the recovered DCM and then "flush" the oil in the rotovap with a liter of heptane or hexane and recover that as well. Do not rush these steps. You did everything right up until this point so take your time moving forward.

Additional thoughts:

1. Proper PPE should be worn at all times with adequate ventilation and a safety plan. Acids, organometallics and organic solvents can be dangerous. Please refer to the provides SDS sheets.

Aluminum Chloride:
https://www.sigmaaldrich.com/US/en/sds/FLUKA/06220

DCM:
https://www.sigmaaldrich.com/US/en/sds/sial/270997

Notes and considerations:

It is very important to take into account a few details pertaining to the formation of delta 8.

1. **Cbd isolate starting material must be high quality 99.5% or better. Any contaminate in isolate will almost certainly produce moisture which will produce d8**
2. **The reactionary vessel must not exceed 5C during the addition of aluminum chloride. This will cause a jump in delta 8. Chiller robustness will play a HUGE role in this procedure.**
3. **Improper filtration from Activated Carbon or any catalyst carried over in the reaction will result in d8**
4. **Any solvent carried over into distillation will contribute to the formation of delta 8**

5. **If you are on a time constraint with separation additional dcm can be added at a 3:1 ratio however this will decrease the amount of material you can use in a reactor.**

If the recovery of DCM is significantly less than expected under vacuum recovery you can recover the dcm. Switch to a solvent like hexane, add to crude oil and recover that as waste. This will help prevent the carry over of DCM to distillation.

Nitrogen sparging needs to be done via a dip tube not just into the head space. Please place in a way that does not cause interference with the stir motor.

Aluminum Acetate/aqeous/ISO wash needs to be disposed of in a chemical resistant container according to local and state laws.

Adequate ventilation is an absolute NECESSITY performing these reactions. If you cannot do it safely do not do it. Aluminum chloride needs to be added to the addition funnel via a glove box or other device capable of safe addition.