How I make CDS using the "Shot Glass" Method

Making one liter or quart of 25 ppm **C**hlorine **D**ioxide **S**olution - 26 September 2012

<u>Disclaimer:</u>

This procedure is intended to be only informational.

If you decide to use any or all of the information presented here, you do so entirely at your own risk & liability.

#1 PETE type plastic jar with about 16 US fluid ounce (460 ml) capacity used for receiver container. The small black lid used as the reactor will hold 6 ml but will sink with more than 2 ml. Both lids are #5 plastic.

1 quart CDS ↑

← Note the small airspace. I found that the more airspace, a weaker CDS was produced.

As much as 50% less!

34 ppm CDS ↑

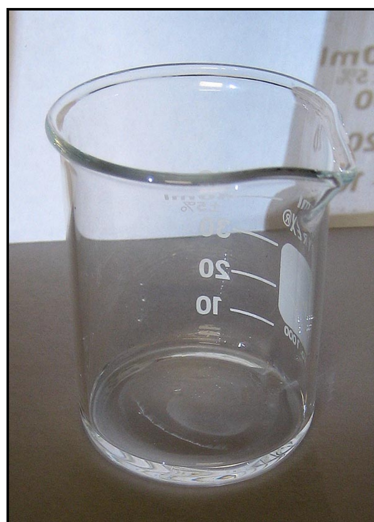
100 mg of CLO2/ml MMS1 was generated with this set of equipment.

<u>The recipe</u> is 7 drops (0.25 ml) of MMS1 and 7 drops (0.25 ml) of 50% Citric Acid combined in the small black lid floated in 350 ml of Distilled Water for 12 hours with the receiver jar tightly capped. This gave me 25 ppm CDS when topped up to 1000 ml total CDS. Note that your dropper must dispense 24 drops per 1 ml for this recipe to be accurate! Or, use a 1 ml syringe.

I always process for 12 hours and place the receiver jar inside a plastic container of some sort in case there is an explosion. Will also hold any CLO2 gas that might escape from the receiver. Temperature about 70°F (21° C)

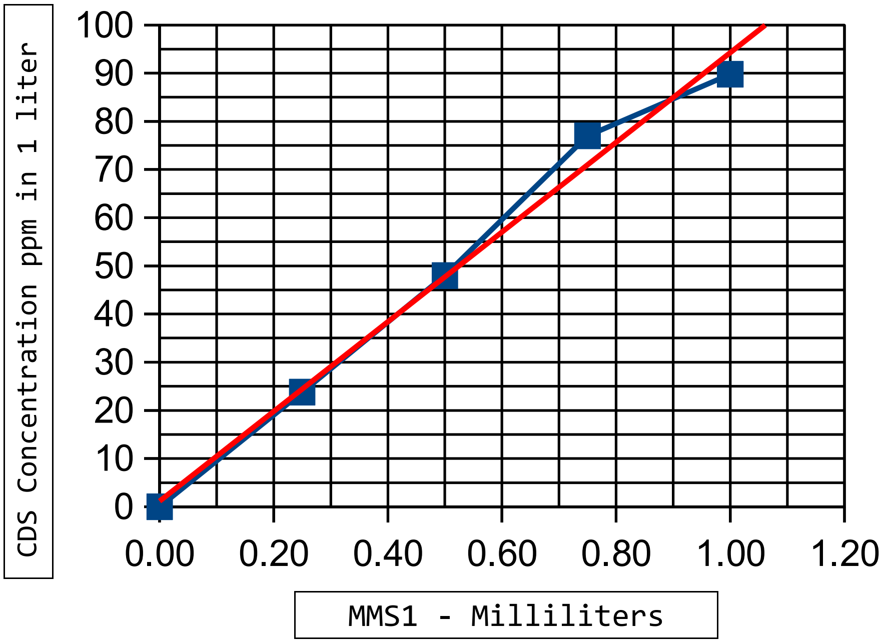
↑ I use this Igloo half-gallon cooler as a safety container.

Reactor solution transferred to a glass beaker to show that it was clear after 12 hours. ↓



CDS Chart - Low Range - MMS1 vs Concentration

460 ml capacity receiver jar filled with 350 ml of distilled water.
After processing 12 hours at 70°F (21°C), 650 ml of distilled water was added for a total of 1000 ml of Chlorine Dioxide Solution.



How to use the chart

This low range chart is designed to help you make one liter of CDS up to 100 ppm.

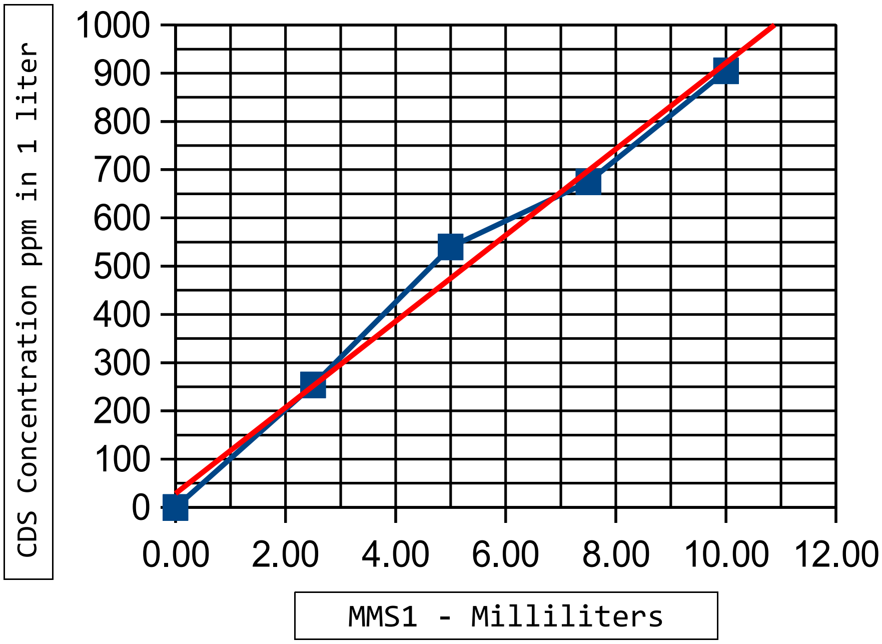
Choose a CDS concentration you want to make. For example, if you want to make 50 ppm CDS, follow across the chart on the 50 ppm line until it intersects the red line.

Then, follow down to the bottom of the chart and read the number, which is about 0.50 ml. That number is the volume of MMS1 you would use to make 50 ppm CDS when using the same size container as noted above, processed for 12 hours at 70F (21C) and topped up to a total of 1000 ml (1 liter) of CDS when processing is finished.

100 mg of CLO2/ml MMS1 was generated with this set of equipment.
(The mg/ml number is just a way to compare different equipment setups)

CDS Chart - Mid Range - MMS1 vs Concentration

930 ml capacity receiver jar filled with 600 ml of distilled water.
After processing 12 hours at 70°F (21°C), 400 ml of distilled water was added for a total of 1000 ml of Chlorine Dioxide Solution.
The reactor container should be at least 55 mm in diameter.



<u>How to use the chart</u>

This mid range chart is designed to help you make one liter of CDS up to 1000 ppm.

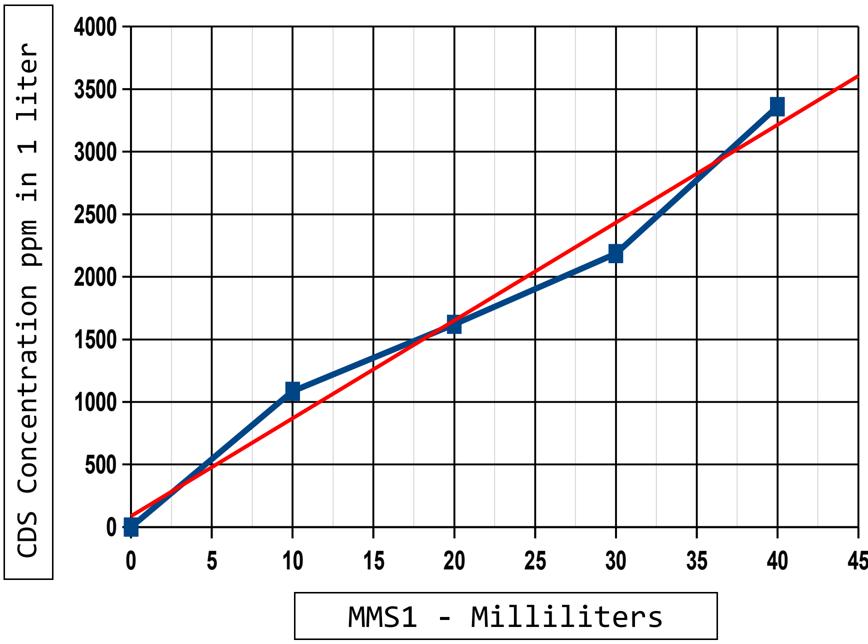
Choose a CDS concentration you want to make. For example, if you want to make 1000 ppm CDS, follow across the chart on the 1000 ppm line until it intersects the red line.

Then, follow down to the bottom of the chart and read the number, which is about 11 ml. That number is the volume of MMS1 you would use to make 1000 ppm CDS when using the same size containers as noted above, processed for 12 hours at 70F (21C) and topped up to a total of 1000 ml (1 liter) of CDS when processing is finished.

91 mg of CLO2/ml MMS1 was generated with this set of equipment.
(The mg/ml number is just a way to compare different equipment setups)

CDS Chart - High Range - MMS1 vs Concentration

2000 ml capacity receiver jar filled with 1000 ml of distilled water.
After processing 12 hours at 70°F (21°C) = Chlorine Dioxide Solution.
The reactor container should be at least 80 mm in diameter.



How to use the chart

This high range chart is designed to help you make one liter of CDS up to 3000 ppm.

Choose a CDS concentration you want to make. For example, if you want to make 3000 ppm CDS, follow across the chart on the 3000 ppm line until it intersects the red line.

Then, follow down to the bottom of the chart and read the number, which is about 37 ml. That number is the volume of MMS1 you would use to make 3000 ppm CDS when using the same size containers as noted above & processed for 12 hours at 70F (21C).

81 mg of CLO2/ml MMS1 was generated with this set of equipment.
(The mg/ml number is just a way to compare different equipment setups)

NOTES

The following are notes I made while testing CDS making using the shot glass method.

1. Receiver air space probably should not exceed 50% of the receiver total capacity. When the airspace was 85% of total vs 50%, the CDS concentration was 16% less. Need to test for CDS concentration when receiver air space is reduced to as little as will allow the reactor to not hit the receiver lid.

2. What is important is having a high volume of receiver distilled water & surface area & and most important is a large reactor surface area.

3. At 12 hours, lots of CLO2 gas can be seen inside a receiver when a low volume of DW was used.

4. Tests prove higher CDS concentration is obtained when the reactor surface area is larger, but there is a point of diminishing returns. Having too little reactor surface area is detrimental to achieving high CDS concentration. Up to 1 ml of MMS1, it doesn't make any difference as there is so little reactor solution.

5. Plastic containers are safer if pressure builds up in the container; they just flex. Little staining noted when using #1 PETE receiver containers & #5 lids even at 40 ml of MMS1. Silicone tubing is also stained by CDS, but dissipates in time or sunlight, too.

6. Tight lids result in higher higher gas pressure in the receiver container & CDS concentration.

7. My current favorite receiver & reactor containers are shown below. The receiver red lid is very tight, when the container rim is cleaned of any remaining seal parts. Since a large reactor surface area is needed, this 2 liter receiver is ideal due to its large 100 mm inside diameter mouth. It is easy to insert & remove the 90 mm outside diameter margarita glass reactor container.

The glass margarita glass reactor is very stable when it floats due to its more exacting construction compared to glass shot glasses I have used. And, the stem helps keep it floating level even when filled with 40 ml of MMS1 & 40 ml of 50 % citric acid. It does not tilt to one side as all my shot glasses do as well as other reactor containers I have tried. And, because of its shape, it will keep small amounts of solution concentrated in one place-it has a dimple at the bottom. I found the pictured margarita glass at a thrift shop for 40 cents. The receiver container is a recycled Costco cashew nut jar.

Here is a wide mouth quart jar cap that seems to seal very well. The older plastic caps did not seal well because they did not have the raised ridges you see in the photo below. This cap is also BPA free.

I have not tried them to make CDS yet, but a jar filled with water upside down in the kitchen sink did not leak out any water overnight.

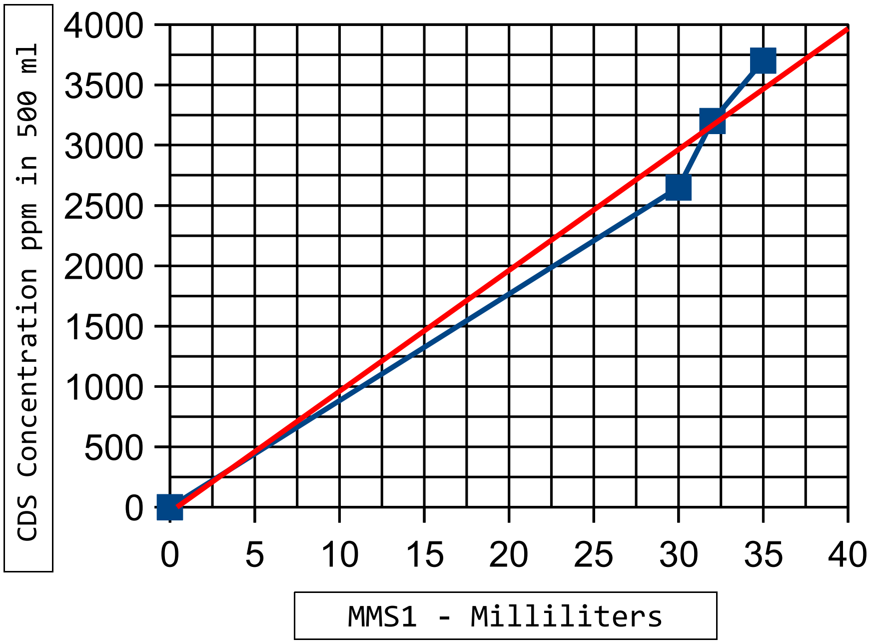
51 mg of CLO2/ml MMS1 was generated with this set of equipment.

Well, I decided to try out this new lid, so there is 40ml of MMS1 and 40ml of 50% Citric Acid in the reactor glass jar you see in the half gallon glass canning jar to the right. After 12 hours, the CLO2 concentration measured 2030 ppm. Lid seemed to be tight as little CLO2 gas was noticed. The surface area of both the receiver and reactor containers is less than the Costco nut jar & margarita glass setup. 40ml of MMS1 would get 3000 ppm with the Costco setup.

Any setup can be used, but to know the PPM, testing strips will be needed. Only when the exact setup is used that I have charted, will you get the PPM listed in the chart.

CDS Chart - Protocol 101 - 3000 ppm

A 1 quart (946 ml) capacity wide mouth Mason glass canning jar is filled with 500 ml of distilled water. The goal is to produce 3000 ppm Chlorine Dioxide Solution after processing 12 hours at 70°F (21°C). The glass reactor container should be about 47 mm inside diameter.



How to use the chart

This chart is designed to help you make 3000 ppm CDS. The goal is to make 500 ml of 3000 ppm CDS. Follow across the chart on the 3000 ppm line until it intersects the red line. From the chart you will see that about 31 ml of MMS1 will make 3000 ppm CDS when using a glass reactor with a mouth inside diameter of about 47 mm. 500 ml of 3000 ppm CDS will contain 1500 mg CLO2. Using Protocol 101's basic daily dosage, this 500 ml of CDS will last 50 days. (30 mg/day x 50 = 1500 mg.)

In this case a modified glass wine glass was used for the reactor. The purchase price from Walmart was $5.00 for a package of four Claret 6 fl oz wine glasses. The stem was removed by cutting it off with a Dremel tool and cut-off wheel. Use all safety measures if you cut the stem off. The Mason jar lid is the new type Ball BPA-free plastic storage cap with jar rim sealing ridges.

48 mg of CLO2/ml MMS1 was generated with this set of equipment.
(The mg/ml number is just a way to compare different equipment setups)

14 March 2013 - Updated 14 April 2013

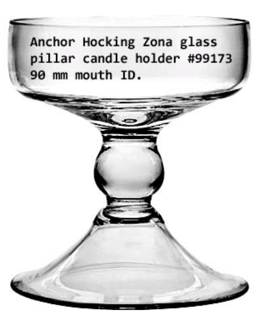
CDS Chart - Protocol 101 - 3000 ppm

A 2 liter capacity Anchor Hocking glass jar with custom lid-seal is filled with 500 ml of distilled water. The goal is to produce 3000 ppm Chlorine Dioxide Solution after processing 12 hours at 70°F (21°C). The Anchor Hocking glass reactor is 90 mm inside diameter.

Anchor Hocking 2 quart (liter) Cracker Jar.
Item # 85787R

How to use the chart

This chart is designed to help you make 3000 ppm CDS. The goal is to make 500 ml of 3000 ppm CDS. Follow across the chart on the 3000 ppm line until it intersects the red line. From the chart you will see that about 18 ml of MMS1 will make 3000 ppm CDS when using a glass reactor with a mouth inside diameter of about 90 mm. 500 ml of 3000 ppm CDS will contain 1500 mg CLO_2. (Dose [mg] = Volume [liters] x Concentration [ppm]) Using Protocol 101's basic daily dosage, this 500 ml of CDS will last 50 days. (30 mg/day x 50 = 1500 mg.)

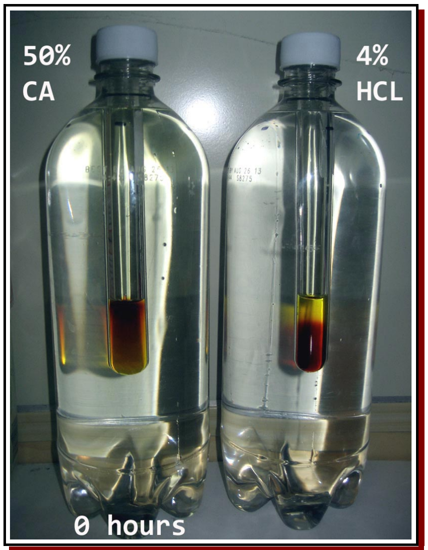


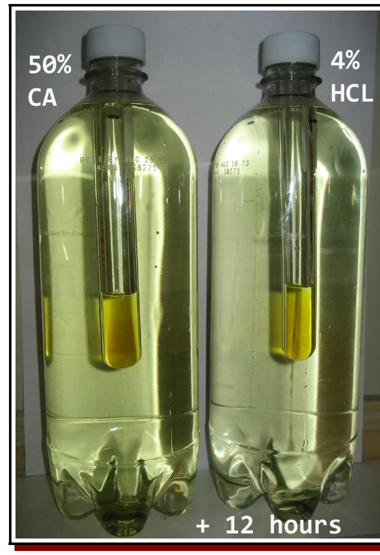
An Anchor Hocking glass pillar candle holder (item # 99173) was used for the reactor. The jar lid for the receiver is from a plastic jar with a custom polyethylene disc-seal made from a 0.032" (0.82mm) thin polyethylene kitchen cutting board. Note that the receiver solution surface area is maximized due to the shape of the reactor stem.

83 mg of CLO_2/ml MMS1 was generated with this set of equipment.
(The mg/ml number is just a way to compare different equipment setups)

14 April 2013

15-16 April 2013 Testing with 1 liter type 1 plastic pop bottle and a glass test tube for 12 hours. Bottle on left used 50% CA and the right 4% HCl. Test tube held 2.5 ml MMS1 + 2.5 ml activator. CA = 87 ppm = 35mg/ml. HCl = 45 ppm = 18mg/ml. (mg clo2/ml mms1). (The mg/ml number is just a way to compare different equipment setups)





17 April 2017 tested same test tube holding 2.5 ml MMS1 + 2.5 ml 50% CA in the Anchor Hocking 2 liter glass receiver holding 1 liter of DW. At +12 hours 62 ppm & 25 mg/ml. → → →

Then tested the same AH 2 liter glass receiver, but used the Anchor Hocking 90 mm diameter glass candle holder reactor. Note the dark color CDS compared to the pop bottles above. ←

At +12 hours 260 ppm & 104 mg/ml.

That is the highest MMS1 conversion efficiency I have ever measured. Which proves the previous observations I have made, that both reactor and receiver solution surface areas need to as large as possible. The spent reactor solution had no color and no CLO2 aroma noticed by my sensitive nose stuck into the reactor. ←

17 April 2013. 12 fl oz (360 ml) jelly jar receiver & Ball white plastic lid, filled with 240 ml DW & modified baby bottle nipple cap reactor filled with 2.5 ml MMS1 + 2.5 ml 50% CA. Start 2307. Stop 1115. 750 ppm 72mg/ml. The modified baby bottle nipple cap was stained yellow, so it can't be used as a reactor. The size of both the receiver & reactor are too small in solution surface area to go above 72mg/ml conversion efficiency and the receiver is not not the ideal cube shape.

18 April 2013 Using a Ball 500 ml capacity canning jar and Ball plastic storage lid, 240 ml of DW was added and in a glass shot glass, 2.5 ml of MMS1 & 2.5 ml of 50% CA was combined for 12 hours. The shot glass rests on the receiver bottom, so sinking is not a problem. 750 ppm. 72mg/ml. Very little color in spent reactor solution. Apparently the size of both receiver and reactor are too small to achieve a higher MMS1 conversion efficiency. Compared to the AH 2 liter receiver and the 90 mm diameter AH candle holder reactor, I was expecting about 1000 ppm with this set of equipment. I guess bigger is better!