Super DESULFATION

eco Globe21

Lead acid battery vital treatment

"To decompose existing SULFATION"

Make difference on Global warming
by spread of Green products from JAPAN

ECO GLOBE 21 Project

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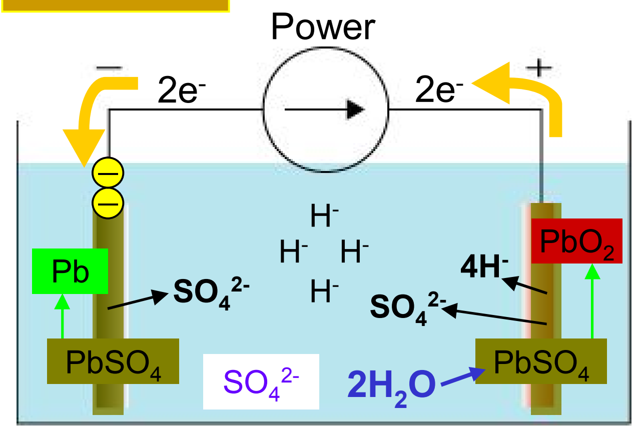
Understanding Lead-acid Battery

Electrochemical reaction of Battery

- Current is movements of electrons
- Negative ion release electrons to be back to the original element (or Molecule)
- Positive ion receives electrons to compose to be back to the original element (or Molecule)

	Minus terminal plate	Plus terminal plate	Electrolyte
Full charge state	Lead (Pb)	Lead dioxide (PbO_2)	**Diluted sulfuric acid (H2SO4)** Sulfate ion SO_4^{2-} & Hydrogen ion H^-
↕	↕	↕	↕
Discharge process	Lead sulfate ($PbSO_4$)	Lead sulfate ($PbSO_4$)	**Water ($2H_2O$)**

Charge Process



	At Discharged state, Plates are covered by $PbSO_4$
-	Supplied electrons to Plate decompose PbSO4 **$PbSO_4$ + $2e^-$ → Pb + SO_4^{2-}**
+	By electric current supply, electrons of PbSO4 to be taken; chemically reacted with Water (H2O) **$PbSO_4$** + $2H_2O$ → **PbO_2** + **SO_4^{2-}** + $4H^-$ + **$2e^-$**

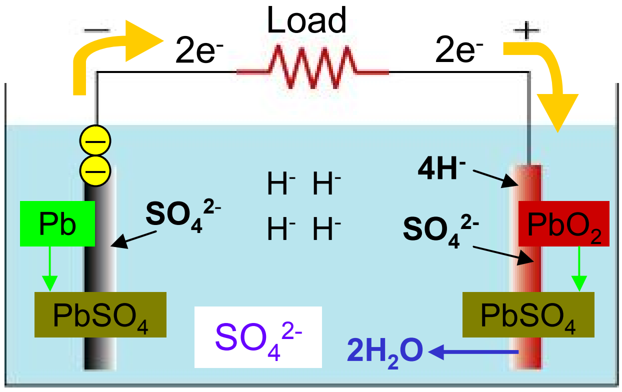
POINTS
1. Forming Lead (Pb) on Negative plate & Lead dioxide (PbO_2) on Positive plate
2. Reaching a high concentration of Sulfuric acid (H_2SO_4)
3. Specific gravity to be increased by the concentration of Sulfuric acid, 1.2 - 1.3
4. Fully charged battery voltage is approx 2.0V
5. Voltage will be approx 2.8V at completion of Full charge state.

- Lead (Pb) & Lead dioxide (PbO_2) to be formed on Plates
- Increasing concentration of Sulfuric acid in Electrolyte

What if, keep continuing to impress Voltage after Full charge state? … bubbles will be appeared.
Bubbles are Hydrogen from Negative plate and Oxygen from Positive plate, starting Electrolyzation of Water.
But it is necessary a little over charging for absolute Full Charge because of partially remaining of PbO2.

Understanding Lead-acid Battery

Discharge Process



	At Charged state, Pb on Negative & PbO2 on Positive
-	Releasing electrons by chemical reaction of Lead & Sulfuric acid **Pb** + **SO42-** → **PbSO42-** + **2e-**
+	Lead dioxide & Sulfuric acid to be chemically reacted by receiving electrons from Negative terminal. **PbO2** + **SO42-** + 4H- + **2e-** → **PbSO4** + 2**H2O**

POINTS
1. Forming Lead sulfate ($PbSO_4$) on Negative and Positive plates
2. Reaching a low concentration of Sulfuric acid (H_2SO_4) and forming Water (H_2O)
3. Specific gravity to be decreased by the concentration of Sulfuric acid, approx 1.1
4. At the battery discharge limit, Voltage is approx 1.8V

- Both plates to be forming Lead sulfate ($PbSO_4$)
- Decreasing concentration of Sulfuric acid in Electrolyte

What if, keep continuing discharging after reaching 1.8V?
… Plates are completely becoming to Lead sulfate ($PbSO_4$); Voltage (Potential Difference) will become 0V. Once reached such complete discharge state, it can not be rechargeable as Battery.

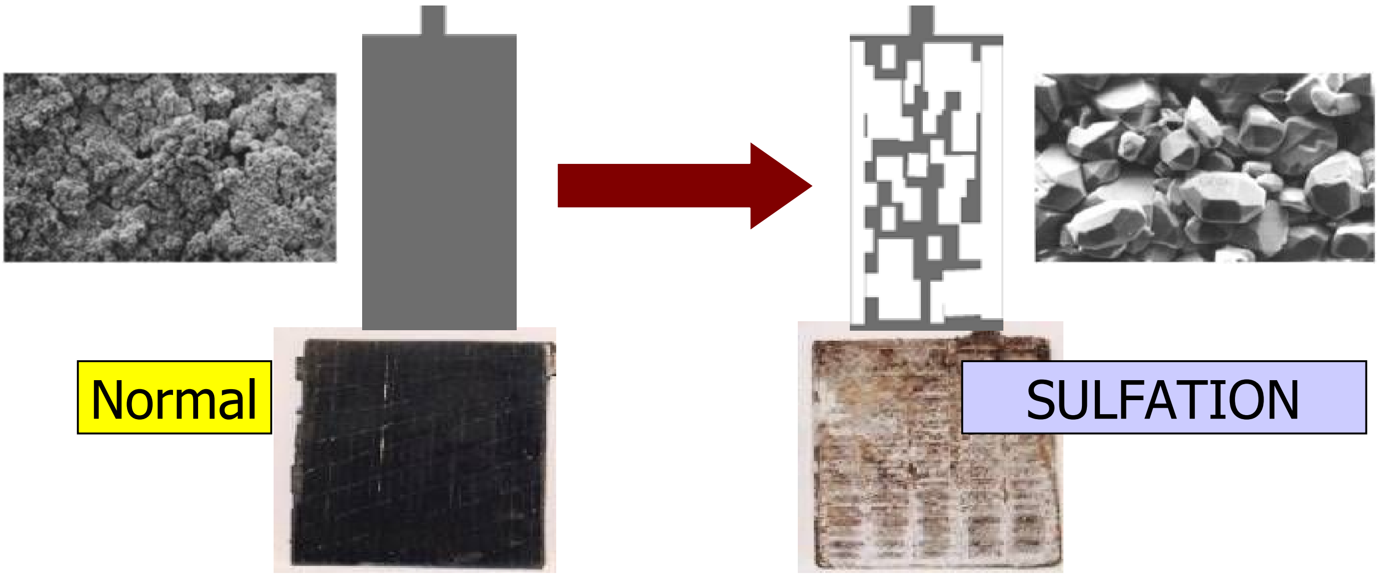
For Start battery, if it discharged more than 20-30% range, it is in critical zone.
For Deep cycle battery, the critical zone will be 50-80% due to the battery designing.

Variation of cells indicates troubles in Battery. One damaged cell can affect the battery function of whole battery unit, especially for Unit cell type batteries like 12V (6 cells) battery.

Other secondary batteries are most likely having weak points on Full charge state use, like Memory Accumulation (or Effects), Shorting lifetime, etc, but “maintaining full charge state” is the most suitable environment for Lead-acid battery.

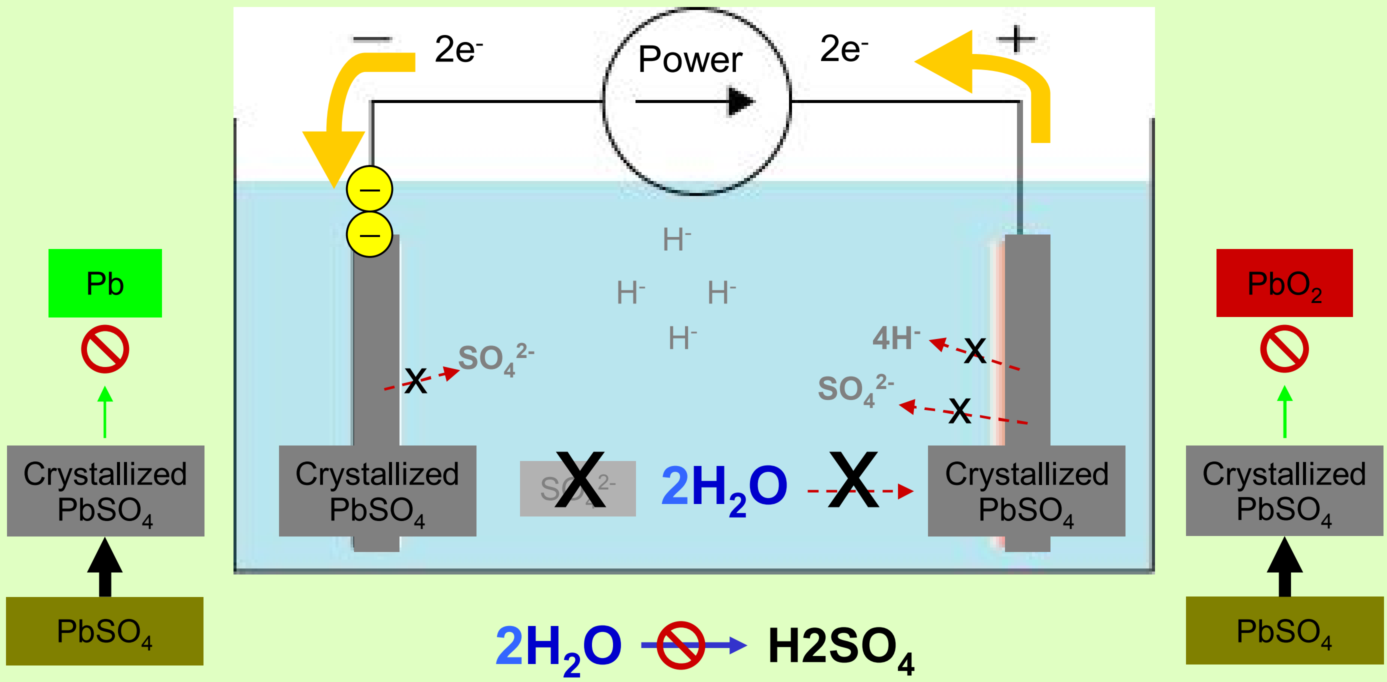
Crystallized $PbSO_4$ as SULFATION

When PbSO4 gets crystallized, it adheres on Plates as Resistance to block electrons, reduces Reacting area of Plates and Power storage capacity.



Charge Process

Crystallized PbSO4 as SULFATION does not decompose during CHARGE.
Water in Electrolyte stay as WATER, therefore Gravity stays as low.



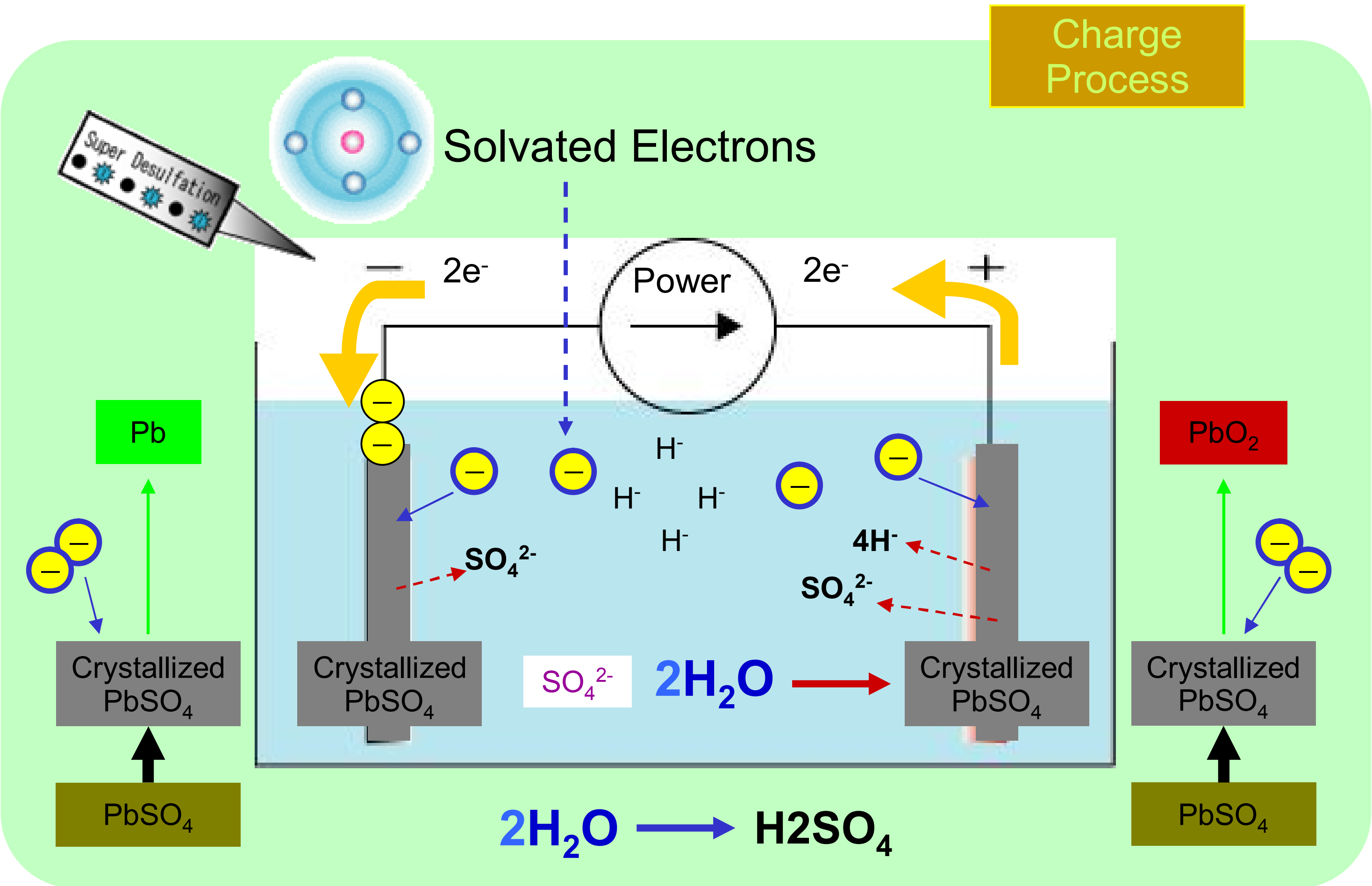
Mechanism of Super Desulfation

★★★★★★★

Super Desulfation is "Solvated Electrons SOLUTION"

Mass of Electrons in pure water

$PbSO_4$ needs to receive 2 electrons to be decomposed during Charge process, and it is possible delivering 2 electrons directly to SULFATION by simply injecting Super Desulfation into Electrolyte.



Work flow chart

Waste | On use | New

① **Visual check of Physical damage**
Take the records

② **Full Charge** (normal charge)

③ Number each cell for taking record
Confirming Electrolyte to be above upper line

④ **Gravity, Voltage, （temp, CCA)**
Take the records

⑤ **Injection of Super Desulfation into Electrolyte**

Cycle
(1 to 3 cycle)

⑥ **Discharge** (50% of discharge depth)

⑦ **Charge (discomoposing)**

Normal use

⑧ **Final Check**
Take the records

decomposing Sulfation / Improving Electro Conductance

【Points of Preparation】

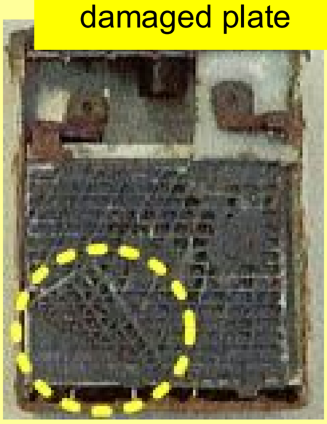
This technology does not concern Physical damage on plates or terminals, therefore it is very important to check Existence of Physical damage.

5-15%
(Most likely on start battery)

Physical damage
- Vibration & Shock
- Deep discharge
- Heat & Cold

- Cracked plates
- Corroded connectors
- Damaged separators
- Shedding H2SO4

Example of damaged plate



Work instruction

① Visual outer check

A) Damage on Case and Terminal?
B) Unusual view on Outer like swelled case?
C) Clearness of Electrolyte？
Brownish-Red color of electrolyte can be suspected high shedding of plate.
D) Plates Exposure and Corrosion?

② **Full charge** (normal charge – 1/10 of battery capacity)

③ Number each cell for taking record
Confirming Electrolyte to be above upper line

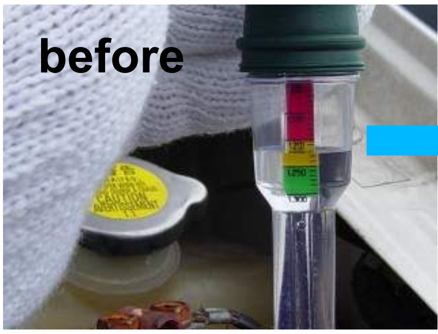
④ Initial measuring: Gravity, Voltage, (Temperature, CCA)

A) Gravity
If random gap is not in 0.04 range, problems of plate can be suspected.
Then, if Electrolyte is dark brown or black haze color, plate can be damaged.

B) Voltage
In case of using Load voltage tester, an internal electric short can be suspected if you find unusual small bubbles during loading.

C) Temperature
Gravity data can be affected by temperature, so it is important for comparing data.

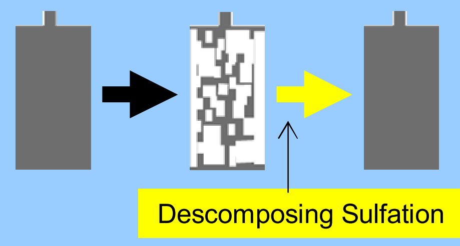
D) CCA and Voltage can be measured simply by CCA tester
(We recommend Midtronics, No-load type.)



The most important point is to make correct judgment of condition of the plates by checking visually and collected data.

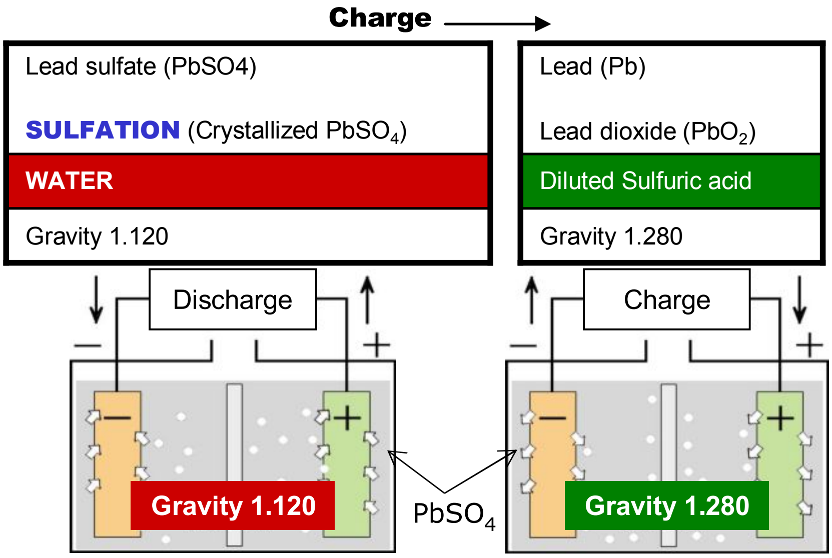
Especially, Uncleanness of Electrolyte and Random gap of above 0.04 Gravity can be common signs of Damaged plates.

Gravity and SULFATION



All possible $PbSO_4$ shall be decomposed at Full charge state.

If Gravity has increased, Crystallized $PbSO_4$ as Sulfation has decomposed.



Relation of Gravity and Charge %

Electrolyte of 20℃	
Gravity	Charge %
1.280	100
1.270	93.75
1.260	87.50
1.250	81.25
1.240	75.00
1.230	68.75
1.220	62.50
1.210	56.25
1.200	50.00
1.160	25.00
1.120	0.00

S20 = Gravity of Electrolyte at 20℃

t = Temperature of Electrolyte

St = Gravity at Electrolyte of t℃

$$S20 = St + 0.0007\ (t-20)$$

Relation of Gravity and temperature

Electrolyte temp.	Gravity at Full charge
40 ℃	1.266
30 ℃	1.273
20 ℃	1.280
10 ℃	1.287
0 ℃	1.294

① High temperature … Low voltage
② High Gravity … High voltage

Plug Voltage ＝ Gravity（20℃ figure）+ 0.84

Work instruction

⑤ Inject Super Desulfation

※ Please check Electrolyte to be between Upper and Lower line to avoid overflow.

R Type (Engine start battery is 2V x 6 cell)			EV・ST type (Commonly used relay of 2V)	
Battery size (Ah)	Inject (cc) / cell	6 cells	Battery size (Ah)	Inject (cc) / cell
21～36A	2 cc	12 cc	25～36A	8 ～ 10 cc
40～75A	3 ～ 4 cc	18 ～ 24 cc	80～75A	12 ～ 15 cc
80～120A	5 ～ 6 cc	30 ～ 36 cc	～1170A	30 ～ 135 cc

※ The injection quantity is just a standard guide, commonly 10-50% of extra quantity to be injected at vital treatment service providers for preventing Sulfation for maintaining the best battery condition.

⑥ **Discharge** (50% of discharge depth)

- Deep cycle for 30% of battery capacity
- Starter battery for 10% of battery capacity

Discharge can be done by discharger, and also can be done by creating load such as lights, fan, heat wire

⑦ **Full Charge** with open lid.

- Standard charge as 1/10 of battery capacity
- Rapid charge as 1/3 of battery capacity
  (over 30 minutes rapid charge might stress Plates)

⑧ Final check

A) Check visibly the clarity of Electrolyte
B) Check gravity of each cell by Hydrometer gravity

C) Check CCA and Voltage by CCA tester *(We recommend above 90%)*

For the most of the cases, CCA should be reached above 90%, but in case of less than 85%, Discharger or creating Load (light, wire, etc.) to discharge about 10% and charge, then check CCA.

If CCA does not rise, might need to repeat Discharge / Charge cycles or inject extra amount up to 50% of Super Desulfation then repeat creating cycle.

D) Check the level of Electrolyte

In case of left over Sulfation on the plate, it will be decomposed during normal use of charge / Discharge cycle.

Test report

Client: Date:

Battery purpose:

Battery spec info (Brand, Name, Ah):

① **Visual outer check** MEMO

	Damage on Case and Terminal ?	
	Unusual view on Outer ?	
	Clearness of Electrolyte ?	
	Plates Exposure and Corrosion ?	
②	Full Charge (prefer Normal charge)	

③ Numbering each cells & Confirming Electrolyte to be above upper line

④ **Initial measuring**

Cell number	1	2	3	4	5	6
Gravity (±0.04?)						
Voltage						
CCA						
(Temperature)						

⑤ Battery type	start ・ deep cycle ・ etc. ( )
Super Desulfation (cc)	
⑥ Discharge	
⑦	Normal full charge with open lid

⑧ **Final check**

Cell number	1	2	3	4	5	6
Gravity (±0.04?)						
Voltage						
CCA						
(Temperature)						
Electrolyte level						