

Pesticide & Ag Plastics Stewardship

10th Annual Conference

February 21–23, 2010 in Savannah, USA

# RadicalPlanet Technology (RPT)

*Chemical Reaction by using Mechanical Energy*

*Alternative Technology for Obsolete Pesticides*

Officially Granted in Japan by the Notification  
(No.25, April 1<sup>ST</sup>, 2004)



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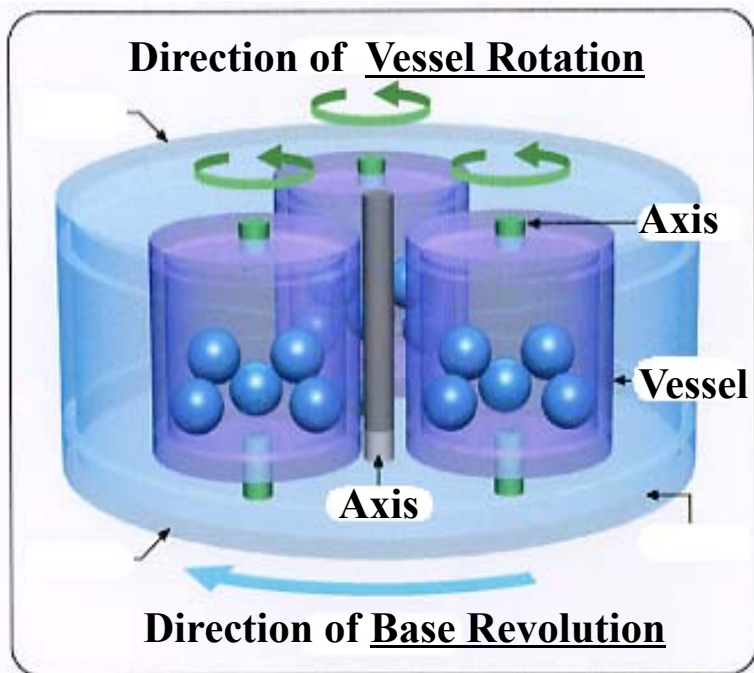
# Chemical Reaction by Mechanical Strong Impact Energy

## High Energy Planetary Ball Mill

*Strong Impact Energy by Reverse Direction*

### 1. Strong Impact Energy:

Steel Balls put out the Strong Impact Energy by the Reverse Direction.



Schematic Profile of Planetary Ball Mill

## Non-Combustion System

*Chemical Reaction by Strong Impact Energy*

### 2. Radical (Activated) Molecules:

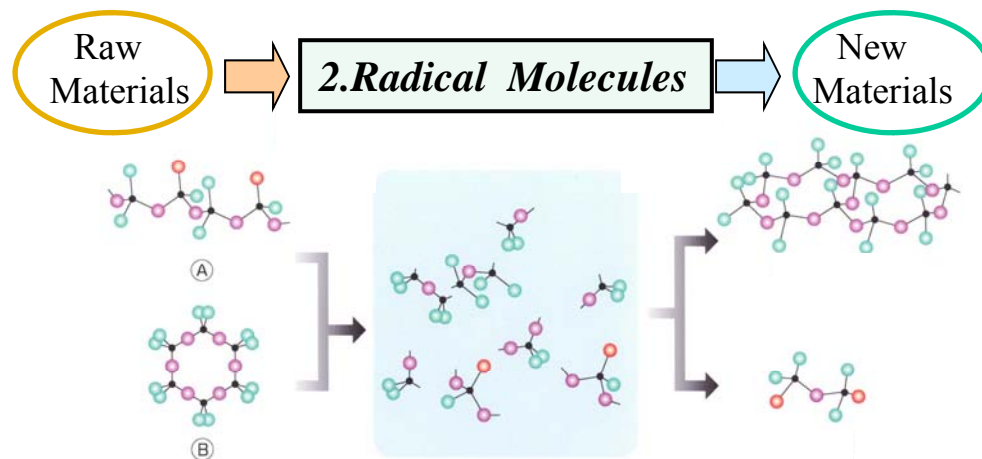
Molecule Bond of Materials are cut up and become to Radical (Activated) Molecules.

### 3. Chemical Reaction:

Small Activated Molecules are occurred Chemical Reaction with each other.

*1. Strong Impact Energy*

*3. Chemical Reaction*



# RadicalPlanet E-200 High-Energy Type: The Biggest Planetary Ball Mill in the World !!

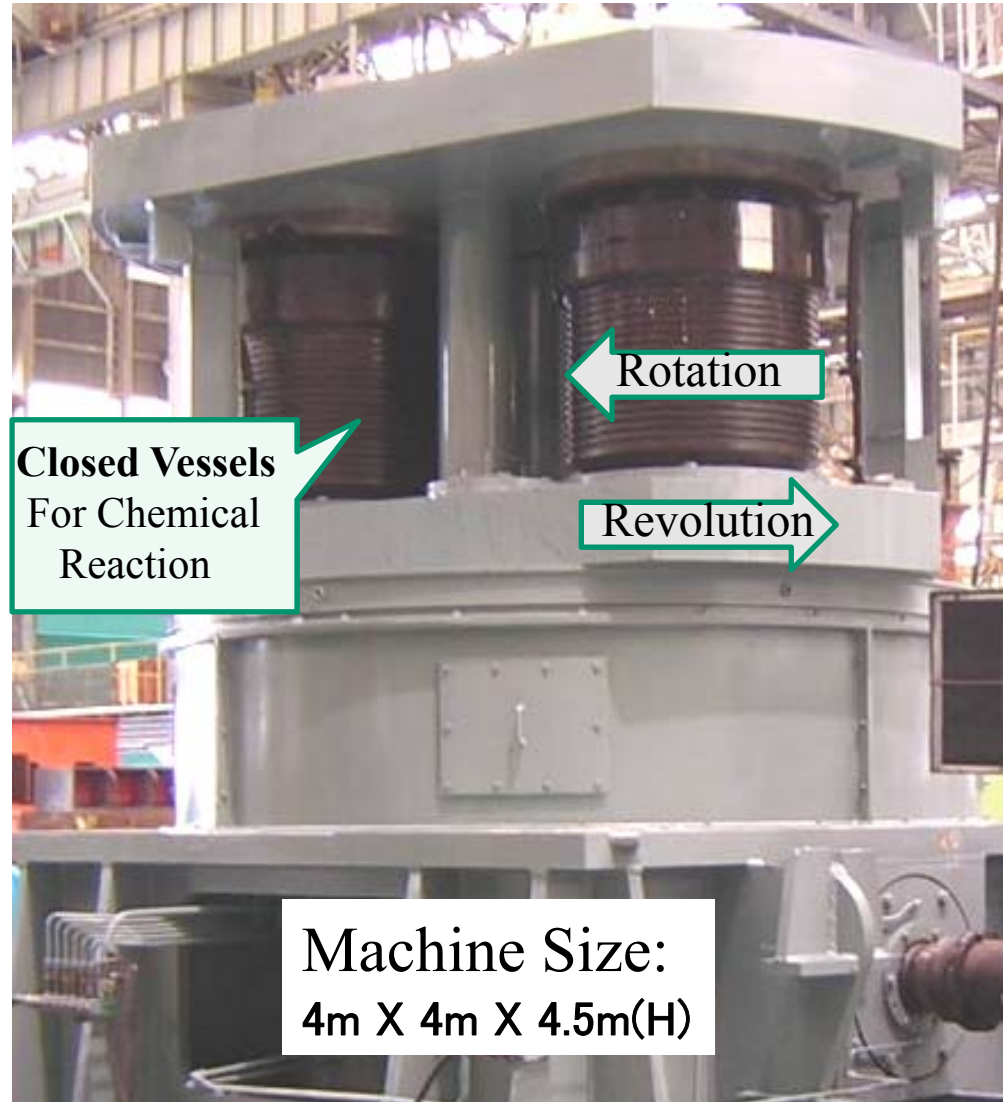
## Alternative Technology for Obsolete Pesticides

### E-200: Practical **Demonstration**-Machine

Vessel Volume : 750 liters  
(Vessel Inner Diameter:670mm)  
Motor : 240kW(option) (AC440V)  
Rotation Speed : 70 rpm  
Revolution Speed : 70 rpm  
Capacity: approx 270 ton-Chemicals/year  
Capacity: approx 1,778 ton-Wastes/year

### A-500: Practical **Commercial** Machine

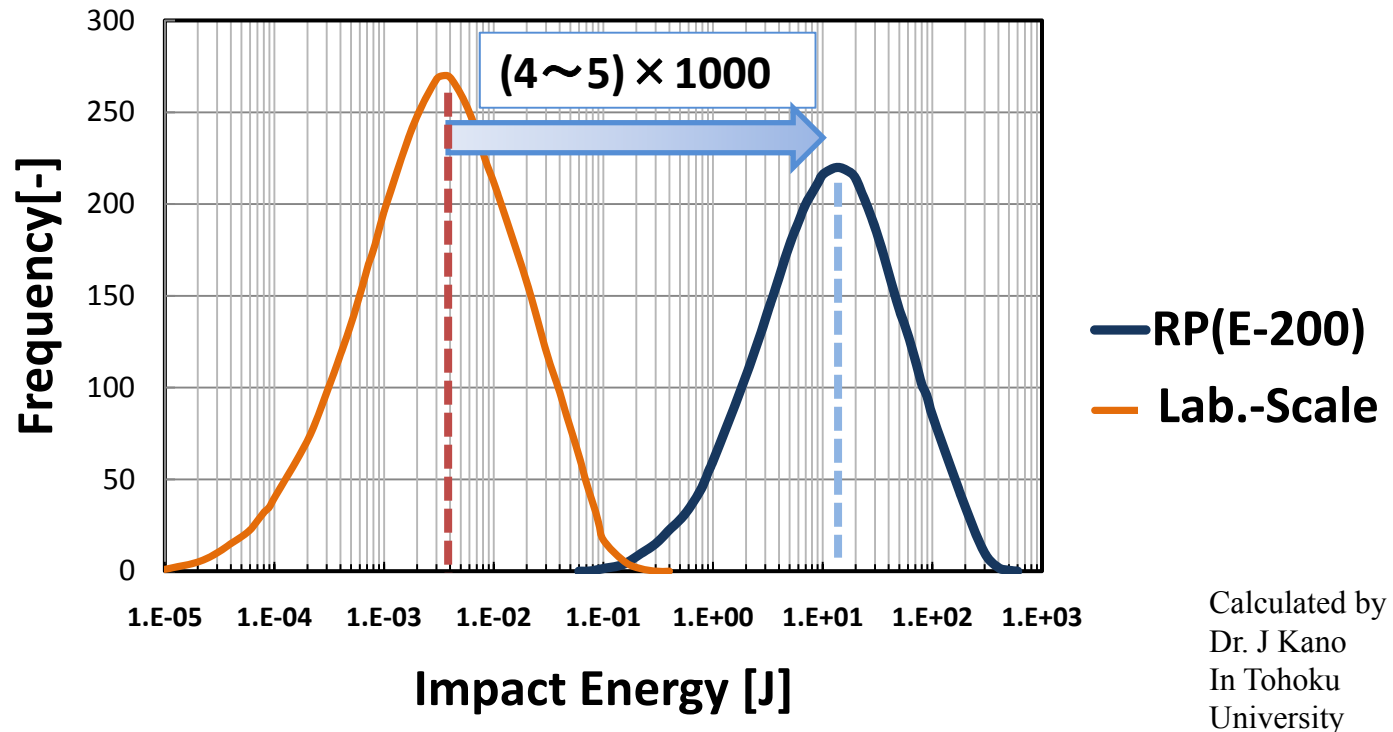
Vessel Volume : 1500 liters  
(Vessel Inner Diameter:1000mm)  
Motor : **550kW**(option) (AC440V)  
Rotation Speed : (70~)100 rpm  
Revolution Speed : (70~)100 rpm  
Capacity: **677 (Max.1,060)**ton-Chemicals/year  
Capacity: **1,610(Max.2,540)** ton-Wastes/year



# Comparison of Impact Energy Concerning the Scale of Equipment

## Planetary Ball Mill

*The Other Mills  
Are Low Impact  
Energy Mills*



1. The **Magnitude of Impact Energy** increased with the **Increase of the Machine Scale**.
2. The Magnitude of Impact Energy in RP-Machine [E-200] is approx (4~5) × 1000 times as much as that in laboratory scale machine.
3. Frequency of Impact Energy is almost similar Distribution
4. Then RadicalPlanet Machine can easily cut off the molecular bonds.

# Comparison of Impact Energy Concerning the Scale of Equipment

*Continue*

4. **The greater** the machine scale is,  
**the more easily** the molecule bonds will be cut off (become to “**Radical State**”)  
and **the more easily** the chemical reaction takes place.
5. **De-Chlorination Reaction by use of CaO (not Metal Calcium)** takes place easily.  
*Ex. POPs, PCB, DIOXIN, FURANS.....*
6. **Carbon-Carbon Bonds** will be cut off (become to “**Radical State**”),  
then **Highly-Polymerized Compounds** become to Lower Molecular Compounds.  
*Ex. PVC, Plastics, Cellulose, Glycerin, Lignin in hard Cellulose .....*
7. **Carbon=Carbon Double Bonds** will be cut off (become to “**Radical State**”),  
then **Benzene Ring** will be opened and Secondary Reaction takes place.  
*Ex. Aromatic Compounds,.....*
8. **Target Inorganic Subjects or Metals** are also become to “**Radical State**”,  
then they are reacted with other Subjects and make a **New Materials**.  
*Ex. Asbestos, Super Special Alloy, Rear Earth metals.....*



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# Applicable Pesticides and related POPs wastes

## 1. Target Materials : All of the POPs Wastes

- (1) PCP, Chlordane, BHC, DDT, ENDRIN, PCB, DXNs, . . .
- (2) Mixture of Pesticides and related POPs wastes
- (3) Admixture (Soil, Stone, Concrete, Glass, Metal, Plastics) polluted by PCB oil and POPs wastes
- (4) Fly ash and Incineration ash polluted by DXNs

## 2. Form and Conditions

- (1) Solid and Powder
- (2) Liquid and Emulsion
- (3) Contaminated Materials (Fluorescent Stabilizer, Impact Paper)
- (4) Admixture of POPs wastes

# Mass Balance and Total Process (example: DDT)

## Detoxification of Pure Pesticides (1) (ex. 100%DDT)

### Theoretical and Recommended Chemical Reaction (1)

Detoxification Reagent : **CaO** Bricks  
(Safe and Natural Object)

### No-Use Dangerous Reagents

No Metal Sodium  
No Metal Magnesium  
No Metal Calcium

**Chemical Reaction :** DDT(C<sub>14</sub>H<sub>9</sub>Cl<sub>5</sub>) + (5/2)CaO = (5/2)CaCl<sub>2</sub> + Organic Chemicals

**Molecule Weight Balance :** 354.5 + (5/2) × 56 = (5/2) × 111 + 217

**Weight Balance :** 1.0kg + 0.39kg = 0.78kg + 0.61kg

**Point !!**

In order to detoxify DDT(1kg)  
Detoxification reagent needs CaO(0.39kg) theoretically.

In order to intend the speed up and the perfection for the detoxification  
Excess CaO (called Angelic CaO) needs 40-250% of the theoretical weight.

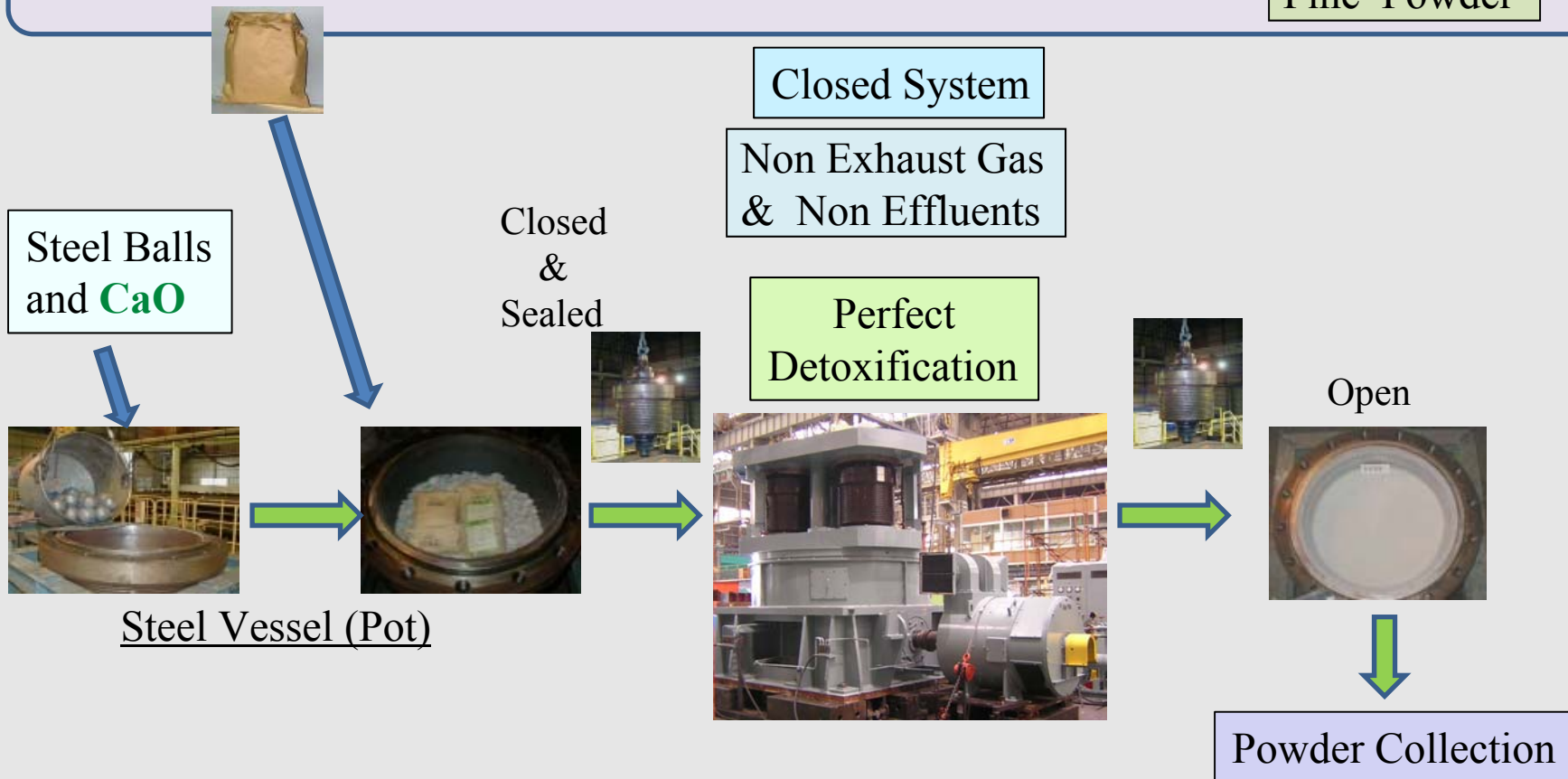
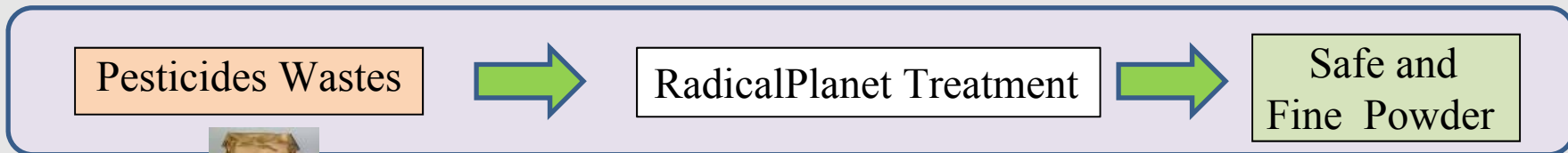
Blast Furnace Slag is also suitable for Angelic CaO.



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# Main Process (Detoxification Treatment)



# Practical Performances (2) *by use of E-200 High Energy Type Machine*

## HCH & Pesticides

Charge into Vessels!

with **CaO**

**emulsion**

Remaining the Bottles



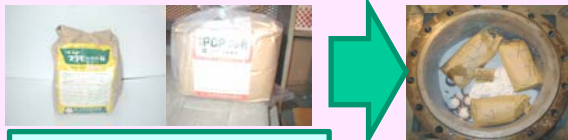
**γ-BHC/Chlordane**

**powder**

Remaining the Card Board



**Endrin/DDT**



**γ-BHC/PCP**

## Destruction & Detoxification *Non-Combustion System*



**Closed System**  
**Non-Exhaust Gas**  
**Non-Effluent Water**

**Reaction Products**



**Safe Powder**

**CaCl<sub>2</sub>**  
&  
**Organic Compounds**  
*(Non-Chlorine)*

**Powder Collection System**

**Results**

Toxic Equivalent Value (pg-TEQ/g)	DREs (%)
≤ 10 (Min. 0.034)	≥ 99.9999

# Practical Performances (1) *by use of E-200 High Energy Type Machine*

## PCB-Oil & Stabilizer

Charge into Vessels!

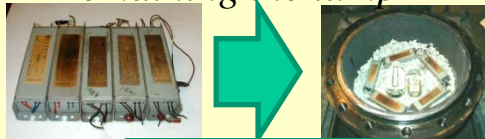
with **CaO**

Remaining the Bottles



**PCB Oil**

Remaining the lump



**Stabilizer**

Remaining the Card Board



**Soil polluted by PCB**

## Destruction & Detoxification *Non-Combustion System*



Reaction  
Products



*Safe Powder*

*Closed System*  
*Non-Exhaust Gas*  
*Non-Effluent Water*

**CaCl<sub>2</sub>**  
&  
Organic Compounds  
(*Non-Chlorine*)

**Powder  
Collection  
System**

*Results*

Toxic Equivalent Value (pg-TEQ/g)	DREs (%)
$\leq 1$ (Min. 0.00027)	$\geq 99.9999$

# Practical Performances (3) *by use of E-200 High Energy Type Machine*

## Soil polluted by POPs(Dioxin)

Charge into Vessels!

with **CaO**

Remaining the Card Board



Repackage



Package



Soil polluted by Dioxin

## Destruction & Detoxification *Non-Combustion System*



*Closed System*  
*Non-Exhaust Gas*  
*Non-Effluent Water*

Reaction  
Products



*Safe Powder*

CaCl<sub>2</sub> + Soil  
&  
Organic Compounds  
(*Non-Chlorine*)

Powder  
Collection  
System

Results

Toxic Equivalent Value (pg-TEQ/g)	DREs (%)
≤ 1 (Min. 0.012)	≥ 99.9999

# Practical Performances (4) *by use of E-200 High Energy Type Machine*

## Admixture polluted by POPs

Charge into Vessels!  
with **CaO**



## Destruction & Detoxification *Non-Combustion System*



*Closed System*  
*Non-Exhaust Gas*  
*Non-Effluent Water*

*Reaction Products*



*Safe Powder*

CaCl<sub>2</sub> + Inorganic  
&  
Organic Compounds  
(*Non-Chlorine*)

**Powder Collection System**

*Results*

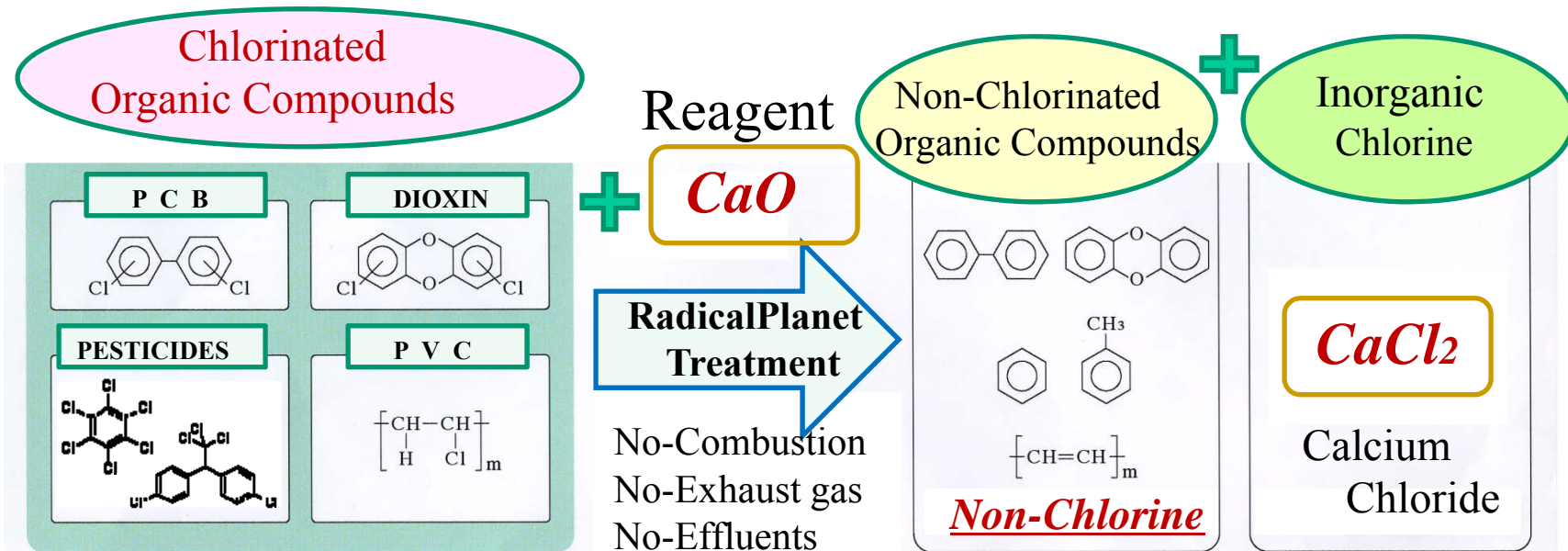
Toxic Equivalent Value (pg-TEQ/g)	DREs (%)
≤ 1 (Min. 0.002)	≥ 99.9999

# Results of Performances *by use of E-200 High Energy Type Machine*

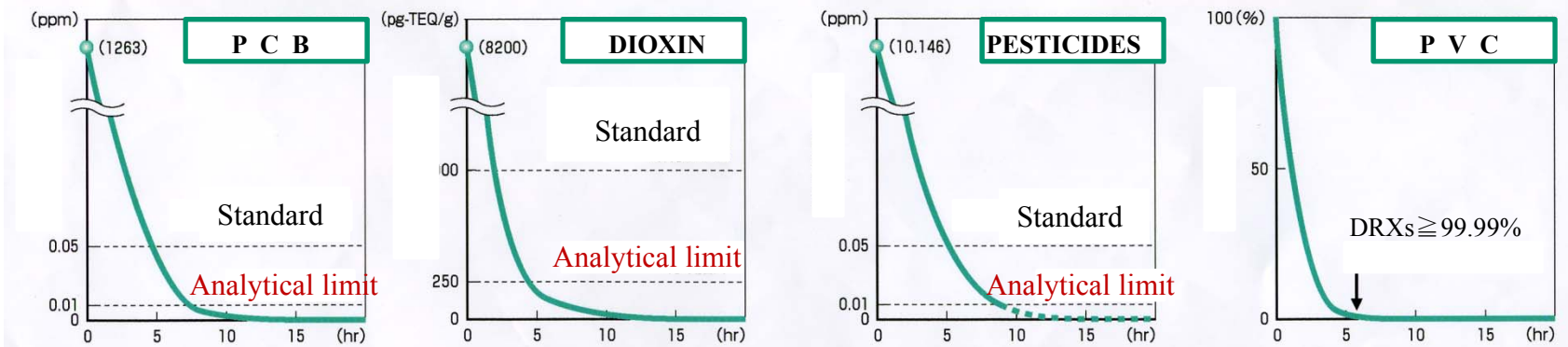
Chemical Wastes	Total Weight (kg)	After-treatment Dioxin+Co-PCB (pg-TEQ/g)	DREs and DEs
97%BHC <p>	12	< 1 (Min.0.31)	DREs $\geq$ 99.9999% DEs $\geq$ 99.99%
5%BHC <p>	28	< 1 (Min.0.14)	
3%BHC <e>	15.6	< 1 (Min.0.38)	
5%DDT <p>	18.5	< 1 (Min.0.08)	
2.5%DDT <p>	5.2	< 1 (Min.0.18)	
2%Endrin <p>	2	< 1 (Min.0.28)	
91%PCP <s>	12.6	< 1 (Min.0.18)	
42%Chlordane <e>	12.6	< 1 (Min.0.034)	
95%Chlordane <e>	3.5	< 10 (Min.6.2)	
20%PCNB <p>	2	< 5 (Min.0.54)	
DDT+Endrin+BHC <mixed-p>	7	< 1 (Min.0.12)	
Undiluted (Transformer) PCB <o>	342	< 1 (Min.0.004)	DREs $\geq$ 99.99999% DEs $\geq$ 99.999%
Stabilizer (2%PCB) <o>	10	< 1 (Min.0.00027)	
Admixture (0.2%PCB) <o>	90	< 1 (Min.0.0018)	
Polluted Soil (4.28%PCB) <o>	125	< 1 (Min.0.004)	
Incineration Ash (Dioxin)	180	< 1 (Min.0.012)	DREs $\geq$ 99.9999% DEs $\geq$ 99.99%
Polluted Soil by Dioxin	200	< 1 (Min.0.012)	
<p>:powder, <e>:emulsion, <s>:solution, <mixed-p>:mixed powder, <o>:oil			



# The Chlorinated Hydrocarbon Reacts Chemically with CaO and Is Altered into Safe CaCl<sub>2</sub> & Non-Chlorinated Organic Compounds



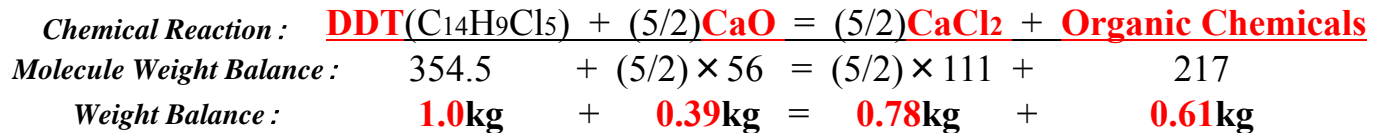
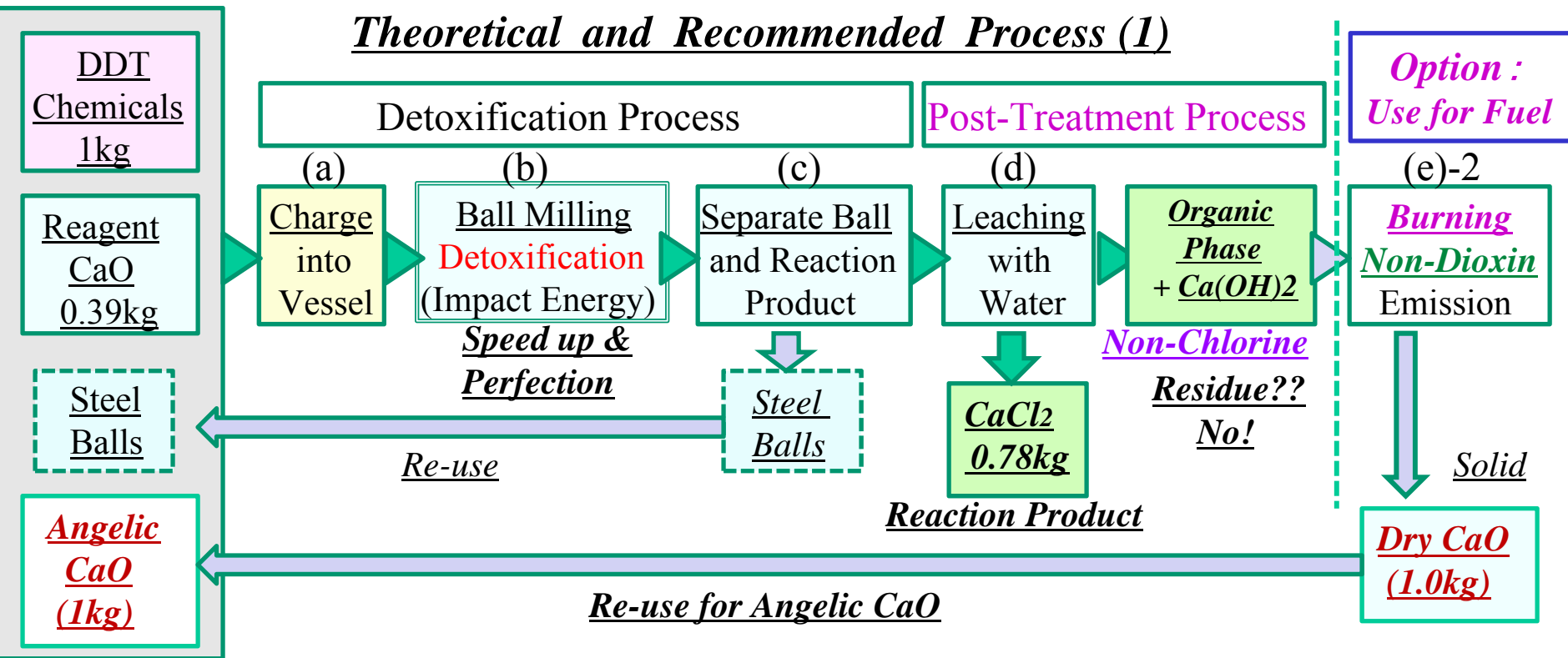
## Behaviors of organic chlorine compounds during chemical reaction



# Recommended Process & Mass Balance of Detoxification

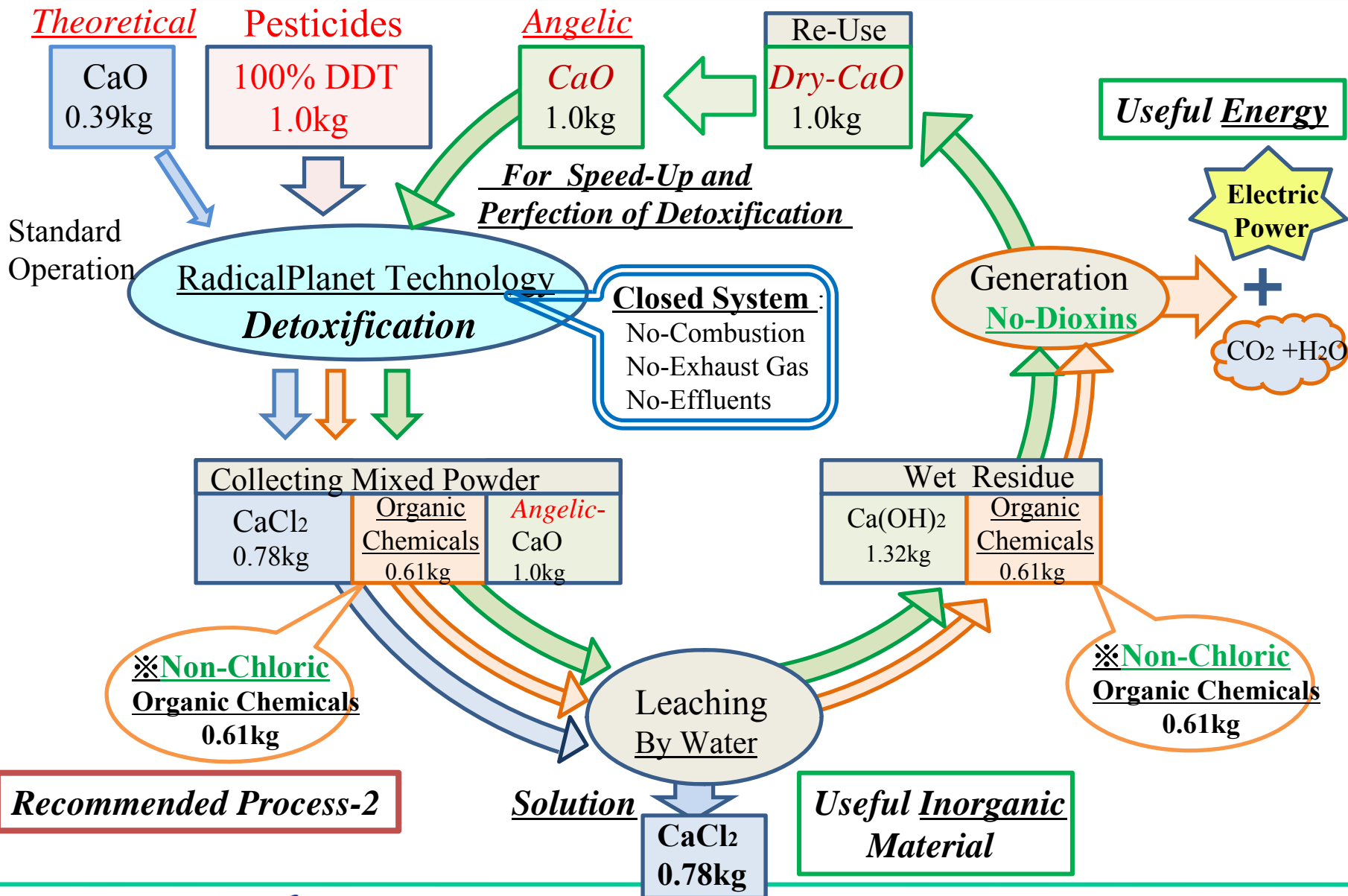
## Detoxification of Pure Pesticides (1) (ex. 100%DDT)

### Theoretical and Recommended Process (1)



In order to intend the *speed up* and the *perfection* of the *Detoxification* Excess CaO (called Angelic CaO) needs 40-250% of the theoretical weight.

# Recommended Process is to be using the Angelic CaO



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# Recommended Process in Ultra-Dilute DDT

*Theoretical*

CaO  
0.0004kg

Polluted Soil  
1kg (DDT=0.1%)

*Angelic*

CaO  
2.5kg

*For Speed-Up of  
Detoxification Reaction*

RadicalPlanet Technology  
**Detoxification**

**Closed System :**  
No-Combustion  
No-Exhaust Gas  
No-Effluents

**Useful hard  
Concrete**

[CaO+SiO<sub>2</sub>]  
3.5kg

**High Strength :**  
Above 400kg/cm<sup>2</sup>  
**Low Alkali :**  
pH = 8 ~ 9  
**Intended Purpose :**  
Road Materials, etc.

Solidification

+ Water Pouring

Burning  
**No-Dioxins**

Collecting Mixed Powder

CaCl<sub>2</sub>  
0.0008kg

⊗ [CaO+SiO<sub>2</sub>] : 3.5kg

⊗ **Non-Chloric  
Organic Chemicals**  
0.0006kg

Wet Residue

[Ca(OH)<sub>2</sub>+SiO<sub>2</sub>] : 4.3kg

⊗ **Non-Chloric  
Organic Chemicals**  
0.06kg

Leaching  
By Water

**Solution**

CaCl<sub>2</sub>  
0.0008kg

**Useful Inorganic  
Material**

**Recommended Process-9**



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# Recommended Process in Ultra-Dilute DDT

*Theoretical*

CaO  
0.0004kg

Polluted Soil  
1kg (DDT=0.1%)

*Angelic*

CaO  
2.5kg

*For Speed-Up of  
Detoxification Reaction*

*Useful hard  
Concrete*

[CaO+SiO<sub>2</sub>]  
3.5kg

**High Strength:**  
Above 400kg/cm<sup>2</sup>  
**Low Alkali:**  
pH = 8 ~ 9  
**Intended Purpose:**  
Road Materials, etc.

RadicalPlanet Technology  
*Detoxification*

**Closed System:**  
No-Combustion  
No-Exhaust Gas  
No-Effluents

Collecting Mixed Powder

CaCl<sub>2</sub>  
0.0008kg

⊗ [CaO+SiO<sub>2</sub>] : 3.5kg

⊗ *Non-Chloric  
Organic Chemicals*  
0.0006kg

*Solidification*  
+ Water Pouring

*Extra low  
Calcium-Chlorine*

**Perfect Non-Heating Process**

*Recommended Process-9*



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# Production of *High-Function Concrete Materials* from the Residue

## High-Function Concrete Material

Radical Molecules  
Make A Strong Bond  
Structure System

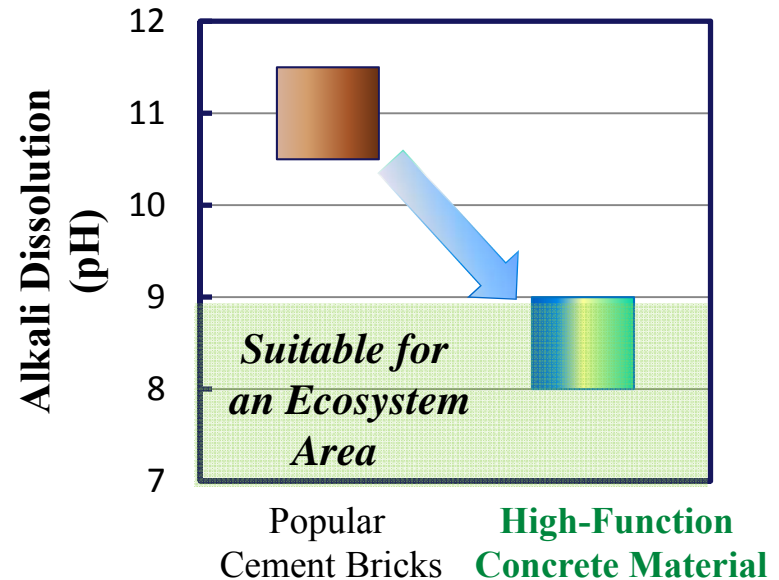
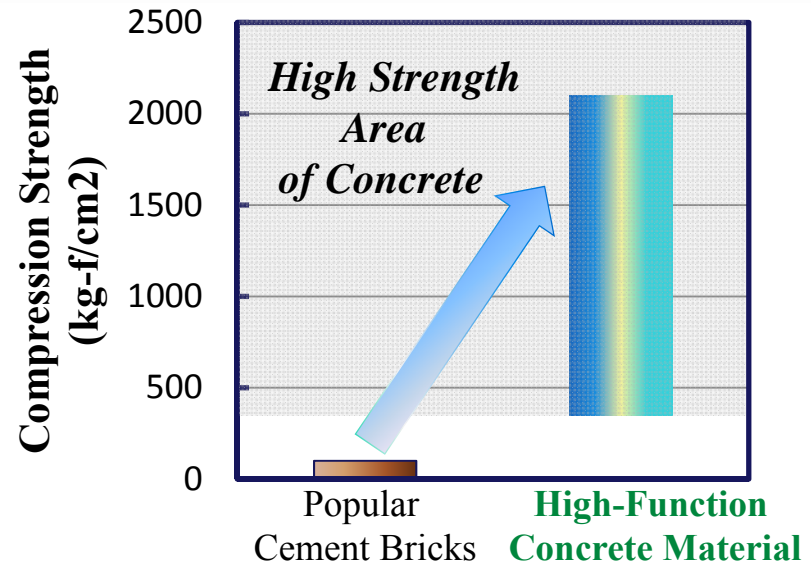
### Mechano-Chemical Effect !!

Feature-1 : Upper Figure

The compression strength :  
Increased as much as  
Concrete Strength

Feature-2 : Lower Figure

The alkali dissolution (pH) :  
Decreased as low as  
Ecosystem



## Re-Use of Final Products (and Residue) -2

Almost products (and Residue) are re-used as useful materials

### For **Pure** Chemicals (Pesticides)

1. **Reagent [CaO]** is used together with **Angelic [CaO]**.
2. **Angelic [CaO]** is reused again as **Angelic [CaO]**.
3. Residue  $\text{CaCl}_2$  is used for Calcium-Apatite or Anti-freezing Agent or so, and Non-Chlorinated Organic Compounds become a Fuel.

### For **Dilute Soil** polluted by POPs

1. **Reagent [CaO]** or **[Blast-Furnace Slag]** is used together with **Angelic [CaO]**.
2. Residue are used as ***Soil* or *Hard-Concrete***, after mixed with water and others.

All Equipments are optional after Collecting the Powder Products



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# Applicable Size of Pesticides and related POPs wastes

*The Vessel of A-500 has one meter in diameter, **1500 liters** inner-volume :*

The suitable receptacle-size of Pesticides and POPs wastes :

1. [Pesticides + CaO] Weight :  
=214 - 387 kg/charge

2. [Pesticides + CaO] Volume:  
=190 - 300 liters/charge

## *Acceptable Receptacles*

1. Card board
2. Plastic box
3. Glass bottle
4. Rayon bag
5. Thin metal can

\* Depend on Figure of small repackaged bags of Pesticides

\* If: Large drum (200 liters) and the other large one :

These Pesticides and POPs wastes  
should be **repackaged** to the above size.

# Capacity & Power Consumption of A-500 Type [in Case of DDT(solid)]

Rapid(100rpm)		CaO /DDT(Soil)	Capacity	Volume	
Angelic CaO=1.5			E-Consumption	Normal	Maximum
Pesticides Chemicals	100% DDT	1.0	t/y	667	1,060
			kWh/t	3,600	2,300
Pesticides Wastes (ex. Soil)	0.1~10% DDT	0.1	t/y	1,610	2,540
			kWh/t	1,510	960
Unknown?	100%-0.1% DDT Or Polluted Soil	1.0~0.1	t/y	667	2,540
			kWh/t	3,600	960

The Radicalplanet Equipment is simple and compact in transit.  
A-500 Type can be separated into two pieces for transport by large-sized trucks.

## On Site Treatment

Site A in area X

## On Site Treatment

Site B in area Y

Photo is E-200 type



A. Discharge of the plant at port



B. From ship to trailer



D. To the workshop



C. Plant carried on trailer

1. Power source : AC440V, 550kw, 3φ, 60Hz and AC 220V, 30kw  
<Diesel generator can be operated.>
2. Water requirements : Main treatment plant requires cooling water which is recycled through heat exchangers.
3. Gas volumes : No gas and no fuel is consumed in the detoxification reaction.  
After detoxification treatment , air or inert gas will be used for safe powder collection.
4. Reagents volumes : In this technology, the reagents such as **CaO** may be added.  
In order to treat 1 kg DDT Wastes,  
0.39kg CaO is needed for detoxification, theoretically.  
The **all Chlorine in DDT** should be reacted with CaO and be altered into CaCl<sub>2</sub> (0.78kg).
5. Weather tight building : The main treatment plant and working field will be required to be protected from the rain, strong wind and the direct sun-shine.  
<The **required space** for installation of A-500 with motor will be **approx 100m<sup>2</sup>** >

### 1. No-Risks of Reagents applied

Extremely safe and popular reagents are applied in this technology, such as CaO which is popular material in soil. [No Sodium, No Magnesium···]

### 2. No-Risks of Technology

- The practical scale machine E-200 was already operated in Japan and officially granted by the notification on April 1<sup>ST</sup>, 2004.
- The polluted materials never expand, because this process is a closed system and never generate the exhaust gas and effluents during detoxification reaction.

### 3. No-Risks of Operation

- At the emergency, the system can be shut down completely and automatically.
- At the earthquake and natural phenomena, the system is stopped safety, immediately, automatically and completely.
- After then, the system can be continued to operate again safety.
- During the stopped periods, the operating vessels are kept to be closed tightly.

## Noticeable Features

Difference Points  
from the Other Technology

Driving Force for  
Chemical Reaction

**Physical Energy**  
(*Mechanical Impact Energy*)  
(*Ease to operate safety*)  
(*Ease to transportable*)

**No Incineration**  
(*Non-Super Critical*)  
(*Non-High Temperature*)  
(*Non-High Pressure*)

Detoxification  
Reagent

**CaO** (Calcium Oxide)  
(*Safe and Natural Object*)

**No-Use Dangerous Reagents**  
(*No Metal Sodium*)  
(*No Metal Magnesium*)...

Detoxification  
Reaction

**Non-Exhaust Gas**  
**Non-Effluent Water**

**No Emission**  
(*No HCl & Cl<sub>2</sub> Gas*)  
(*No Generated Dioxin*)

Reaction Area

**Closed Vessel**  
(*Perfect Destruction*)

**Safe at Urgent Stop**  
(*keep on the condition*)

Residues

**Re-Use, Re-Cycle and Fuel**

**Use as high efficient Materials**

# Indicative Tentative Rough Estimates

It is difficult to give a price at that stage.

It will vary very much from availability and cost of qualified local staff and energy.

**We can give following indicative tentative rough estimates:**

1. Installation and operation of a ***pilot phase treatment facility (E-200)***  
for **1 year**: 2.6 Million USD  
(estimated throughput about **100 t/year**)

2. Installation and operation of a ***small scale treatment facility (1x A-500)***  
for **5 years**: 26 Million USD  
(estimated throughput about **3,780-6,120 t/5 years**)

3. Installation and operation of a ***bigger scale treatment facility (3xA-500)***  
for **5 years**: 64 Million USD  
(estimated throughput about **11,340-18,360 t/5 years**)

As it can be seen there is definitively an economy of scale.

Further depending on the existing boundary conditions  
the system may be optimized in order to reduce costs and/or increase throughputs.



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**Thank you very much  
for your attention.**

We are looking for  
(1) Users and  
(2) A Business Partner



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