RADICALPLANET TECHNOLOGY (MECHANOCHEMICAL PRINCIPLE)

Provisional version

Name of Process:
Radicalplanet Technology

Vendor:
Radicalplanet Research Institute Co. Ltd.
Web site: http://www.radicalplanet.co.jp/en

Applicable Pesticides and related POPs wastes:

1.Materials:
(1) PCP, Chlordane, BHC, DDT, Endrin, PCB, DXNs
(2) Mixture of Pesticides and related POPs wastes
(3) Admixture (Soil, stones, concrete, glass, metal, plastics) polluted by PCB oils 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, Paper)
(4) Admixture of POPs Wastes

Status:

1. Pilot Commercial Treatment plant Operation (200kg/charge by the use of E-200 Type)

(1)1999-:Detoxification of Soil and Ash contaminated by DXNs.
(2)2000-:Detoxification of Pesticides and POPs wastes.
(3)2001-:Decomposition and detoxification of PCB oil, mixture and contaminated soil and stabilizers

2. Commercial Treatment plant Operation
The commercial system was planned to start in September, 1999, and was operated in January, 2000. Full scale one was operated in February, 2000, in order to detoxify the POPs Wastes delivered by Japanese Government. The technical system was named "Radicalplanet technology" in April, 2003.

3. Authorization by Government.
The permission to apply the "Radicalplanet Technology" was officially granted by the Notification No.25 (April 1, 2004) of the Environment Ministry in the name of the "kikai kagaku bunkai hoho" (mechano-chemical decomposition method) under the law for special Measures in relation with the law for PCB (and POPs) waste disposal.

4. New designed Treatment Plant, A-500 type
In 2006, A-500 type is designed for double capacity of the E-200 type in order to operate at large scale.

5. Plan to re-start
The commercial system (E-200: demonstration machine) is planned to re-start in 2008 at a new location.

Technology description:

The aim of "Radicalplanet Technology" is the complete detoxification of harmful compounds (e.g. Chlorinated organic compounds), into safe compounds under non-heating, atmospheric conditions and in a closed system by the Mechanochemical principle. While the Pesticides, PCB, and related POPs wastes are treated no exhaust gas and effluents are generated. There is no danger of secondary pollution due to transportation of the harmful compounds, because the system is very flexible and can be moved easily and is able to treat the pollutant on site. In addition, this process guarantees clean conditions because the reaction is created by mechanical energy without producing combustion gas. In concrete, steel balls crush each other hard under non-heating conditions. The bond of each molecule is, therefore, cut by mechanical energy. The molecules are decomposed into the state of activation, called the radical state, so that chemical reaction is accelerated.

In case of chlorinated organic compounds, when a physical energy greater than a specific strength is exerted, the compounds containing chlorine will be chemically activated (as chlorine and carbon bonding is weaker, chlorine and carbon will be separated each other). The de-chlorination reaction takes place without heating the harmful compounds. The additives such as CaO may be added depending on the desired end products (commercial products). In any case, safe and less expensive additives are selected for specific purposes. The chlorines in radical state combine with CaO in the vessel, and produced chlorinated inorganic compounds, $CaCl_2$, Ca(OH)Cl, which are stable compounds. The organic compounds become harmless compounds which do not contain chlorines

"Radicalplanet Technology" process means that the technical method can decompose the molecules into "Radical" state by use of the "Planetary mill" and simultaneously change the harmful compounds entirely into substances of different molecular structures (target substances) by causing chemical reaction with introduced non-harmful substances in the closed system without heating the materials.

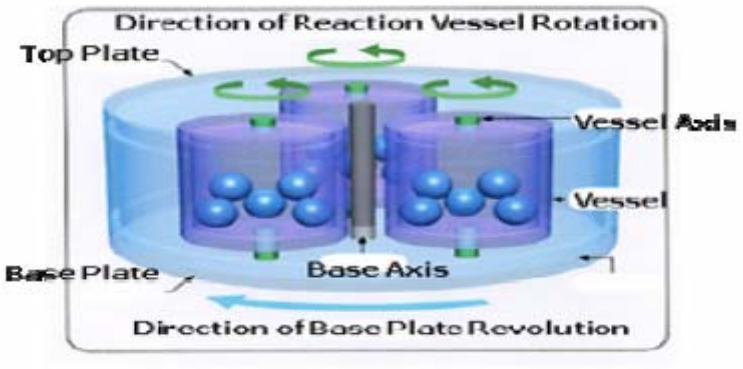

Figure 1 Schematic Profile of Planetary Mill

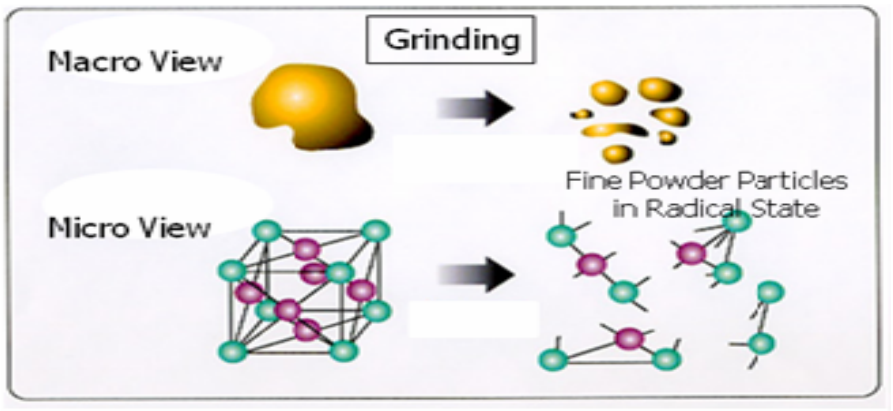

Figure 2 Means of Grinding (Fine Powder Particles in Radical State)

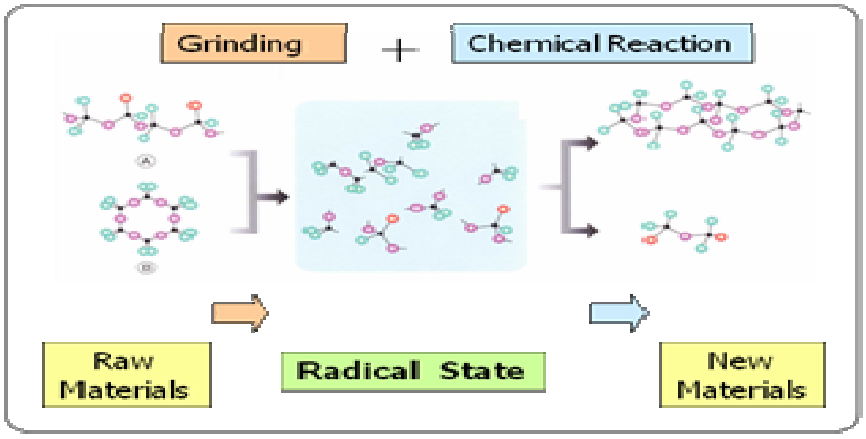

Figure 3 Mechanochemical Reaction (Chemical Reaction with Non-Combustion)

Characteristics of the Radicalplanet Technology

(1) No heating is required for the reaction to take place. Only the mechanical rotating force is required by an electric motor.

It is a non-combustion system, involving safe reactions with minimum side reactions.

(2)No exhaust gas and no effluents such as harmful organic compounds will be generated.

The reaction of detoxification occurs in closed vessels.

Minimum energy consumption (no heating required), and no generation of CO_2 gas.

The system is simple, clean and operated at low cost.

(3)Cleaning and disposal process is flexible and can also be done on site.

The process is highly safe since no transfer of the polluted substances will be needed.

The treatment plant is movable and compact and can be easily assembled at the POPs stock place.

The system contributes to environmental preservation and minimizes the concerns of the local communities and the workers. It is highly cost effective, because the maintenance of main equipment is very simple and the only expendables are the steel balls and the inside wall of vessels.

(4)The system is resource saving and highly effective. Safe detoxifying agents, including CaO (SiO_2, Al_2O_3) are used. The bricks of CaO is Lime stone or the slag of blast-furnace. After detoxification, the compounds may be reused and recycled for materials of concrete blocks.

(5)In case of emergency the system can be shut down completely.

In case of earthquakes and other natural phenomena, the system can immediately completely be stopped in full safety, and thereafter the system can be continued to operate again safely.

Process diagram:

The schematic processes of Radicalplanet Technology are shown in Figure 2.

1.Pre-treatment

Due to the sizes of the vessels E-200, 125 l (max) and A-500 250 l (max) waste should be delivered in small packages. See also under Part I

2.Pesticides treatment (Detoxification Process used the Radicalplanet Technology) See Figure 4

At first the steel balls insert into each reaction vessel. Next the detoxification agency, CaO, is put into each vessel. Finally the repacked pesticides and POPs wastes are gently put on the detoxification agency in each vessel by hand operated or by an automatic insert machine. For example a belt or pan conveyer system can be used, except for glass bottles. Thereafter, the reaction vessels are closed by exclusive caps. After closing the reactor vessels, these vessels will be set on the radicalplanet machine, the rotation will start. The detoxification reaction will take about 3 (-6) hours at a rotation speed of 70rpm. The detoxification time will be decreased to approximately 1.5 (-3) hours at a rotation speed 100rpm. All of the pesticides, POPs wastes and the detoxification agency, CaO are changed into fine and activated powder which is safe (the toxic equivalent of DXNs < 1 pg-TEQ/g) perfectly. The organic chlorine compounds are decomposed and changed into the non-chlorine organic compounds. The chlorine were converted to inorganic compounds called $CaCl_2$ or Ca(ClOH). During the detoxification reaction, no exhaust gas and no effluents occur.

(1)The standard capacity for the amounts of pesticides and POPs wastes in one treatment plant per 24 hours and the decision of the ratio of the detoxification agent (CaO)/(Pesticides & POPs wastes):

The maximum amount (the density is approximately 2.0) of the pesticides and POPs wastes is approximately 1.1 tons in the treatment plant of E-200 Type (2.1 tons in A-500 Type)per day. The decomposition of the pesticides wastes means that the organic chlorine compounds are changed to the inorganic chlorine compound. POPs Wastes are harmful organic chlorine compounds. In this technology, CaO is used for decomposing the organic chlorine compounds. CaO is activated by the mechanochemical principle, reacted to chlorine and changed into the inorganic chlorine compound called $CaCl_2$ or Ca(ClOH). In order to decompose theoretically the organic chlorine compounds, the two atoms of chlorine in organic compounds need two atoms of calcium in the CaO. For example, the one molecule (285) of pure BHC theoretically needs to three molecules (3×56) of CaO. In other words, one kilogram of BHC is in need of approximately 0.6 kg CaO. In order to make sure that the decomposition reaction takes place, the amount of CaO will be increased two or three times as much as the theoretical amounts. So in order to treat one kilogram of the pesticides Wastes (BHC), the amount of the detoxification agency will be in need of over the 1.50 kg of CaO. And the increase of CaO weight is effective in increasing the speed of the detoxification reaction. But there are some limitation weights in the reaction vessels. The suitable ratio of CaO/pesticides will be selected for each case. The additives such as CaO may be added with SiO_2, Al_2O_3, depending on the desired end-products.

(2)The speed of the vessel rotation and the base revolution:

The rotating and revolving speeds are also very important factors. At the contracted tests on behalf of the Japanese Government, the each speed was prescribed at 70 rpm respectively. The vessel rotation and the base revolution are on the counter direction. However, the rotation speed and the revolving peed had to be increased to 100 rpm respectively in order to promote the detoxification reaction at the commercial and practical operation. With a speed of 100 rpm at the commercial and practical operation, the detoxification reaction speed may increase to twice and the final treating time will be reduced to one half. The reason that the 70 rpm speed was selected at the contracted tests was that Japanese Government required not only the final data but also the intermediate samples in the detoxification chemical reaction. Then the speed of the rotation and the revolution was fixed to 70 rpm at the contracted tests from Japanese Government.

(3)The standard capacity for pesticides and POPs wastes in one treatment plant per 24 hours:

The maximum amount (the density is approximately 2.0) of the pesticides and POPs wastes is approximately 1.1 tons in the E-200 treatment plant (2.1 tons in A-500 Type) per day. In the case of one treatment plant, the amounts of the detoxification will be 670 tons of pesticides & POPs wastes in a year. If there are much pesticides & POPs wastes, several A-500 treatment plants (are recommended) should be operated for the effective treatment. In the case of three treatment plants, the amounts of the detoxification will increase to 2,030 tons per year.

(4) The proper amounts and the size of steel balls:

It is also very important to select the amounts and the size of steel balls. The selection of steel ball has direct effects upon the detoxification reaction speed and the maximum impact energy. The machine, E-200 and A-500 Types, is scarcely fit for commercial and practical use. There are about 100 steel balls in each vessel of E-200 (200 balls in that of A-500) and the suitable size of steel ball is approximately 4 inches diameter.

3.Post treatment (Powder Collection Process):

Approximately 3 hours, after the detoxification reaction, all pesticides, POPs wastes and the detoxification agency, CaO are completely changed into the fine and activated safe powder (the toxic equivalent of DXNs <1 pg-TEQ/g). The next process is the powder collection. Using the collecting equipment, the fine powder may be separated from steel balls in the vessel and sucked into the cyclone powder collector chamber and the bag filter systems with a certain amount of air through a very narrow opening. Exhaust gas which is used for collecting the powder is clean, safe and at room temperature.

4.Optional treatment (Reuse of the Powder):

The technology is resource saving and highly effective. Safe and cheep detoxification agents, including CaO, SiO_2, Al_2O_3 (substances contained in soil), are used. The collected powder may be recycled and reused for new materials like high grade concrete after the detoxification. In other words, as this powder is not only safe and fine but also is activated, it can be solidified at room temperature only by mixing with water, become hard as the concrete structure and be formed

into any shape, for example Tetrapods for coastal protection. The collected powder is solidified by connecting energy called the molecular bond which is caused by activated atoms or activated molecular.

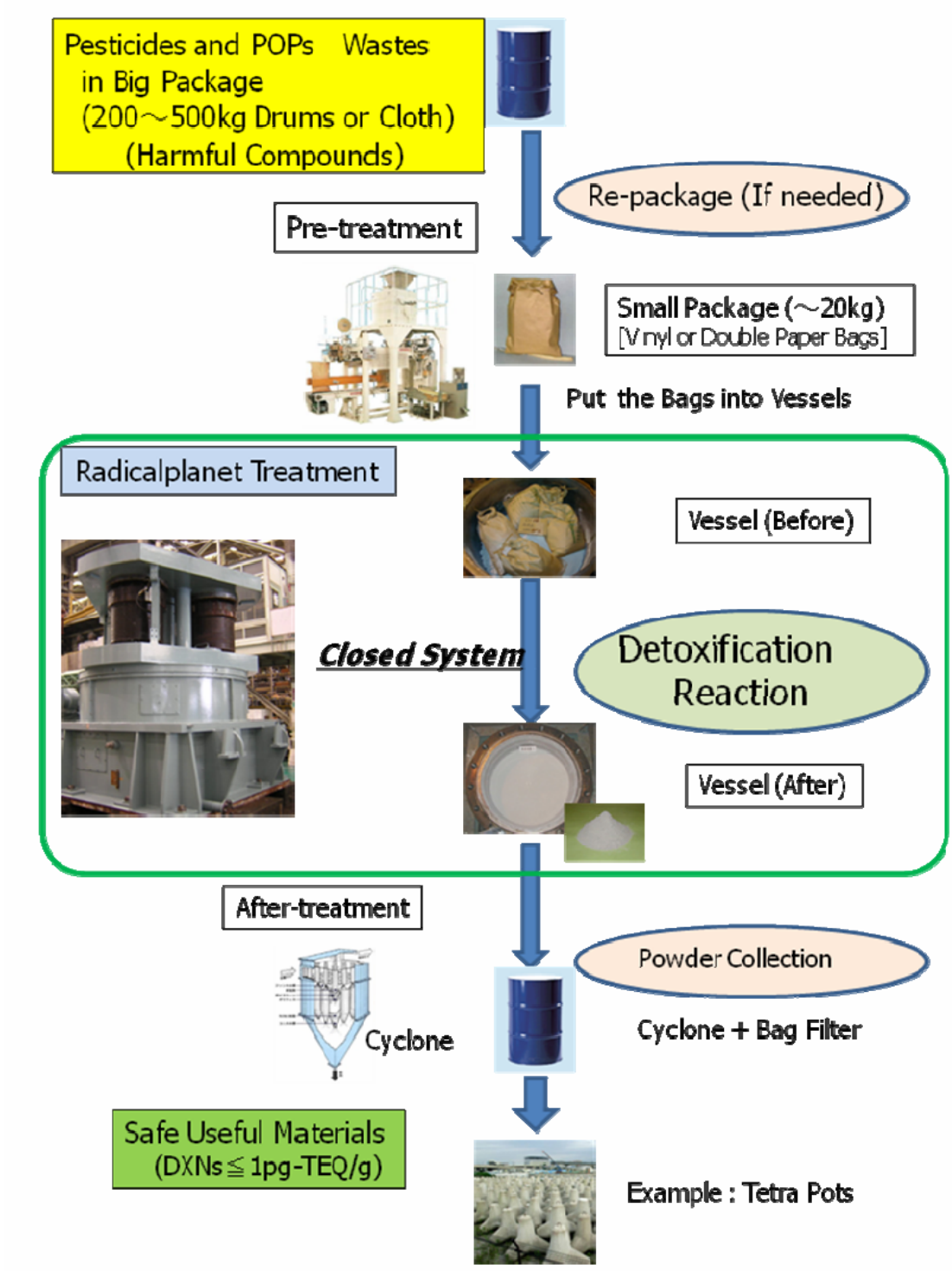

Figure 4
Schematic Profile of Radicalplanet Technology (Practical process for Actual POPs Wastes) takes place

PART I: Criteria on the Adaptation of Technology to the Country

A. Performance:

1. Minimum pre-treatment:

Conditions for acceptance are that all waste is repacked in UN approved packaging materials. However due to the size of the various vessels, the sizes of the packaging is important. Any kind of packaging material such as bags, papers, glass, metal cans be accepted as specified below. If larger sizes are delivered such as 200kg drums or 500kg units, the waste must be re-packed into some small packages made of vinyl, double papers, into glass bottles or into metal cans. After pre-treatment, the packages of the pesticides and POPs wastes are closed in small size as shown in the following Table.

Acceptance criteria for E200 and A500

Type	Max Volume individual packages (litres)	Max weight individual packages (kg)
Solid pesticides in card boxes	20 l	20 kg
Liquids, to be delivered in bottles, pp- or pet- bottles or metal-cans	20 l	2-10 kg and max 10 kg

2. Destruction efficiency (DE):

The results for treatment of PCP, chlordane and Endrin are shown below (7).

Vendor		Radicalplanet Research Institute co. Ltd.(former Sumitomometals co,Ltd.)							
Name of Process		Radicalplanet Technology							
POPs wastes	name	PCP	chlordane	BHC		chlordane	BHC	DDT	Endrin
	figure or state	liquid	emulsion	liquid		emulsion	admixture of powder (underground)		
	Input Weight(kg)	0.7	0.7	0.7	3.5	3.5	2.5	2.5	2
	DXNs(pg-TEQ/g)	1,600,000	990	26	26	190			
Agency for dechlorination: CaO		57.6	69.3	55.2	57.6	55.3	63		
The other added agency: SiO_2		11.7	0	11.3	11.7	11.2	0		
Exhaust gas		non							
Effluents		non							
Powder	Weight(kg)	70.1	71.2	68.1	73.9	71.2	71.5		
	DEs(%)	> 99.997949	> 99.997530	>99.999490	>99.999891	>99.999521	> 99.998903	> 99.999342	> 99.997943
	DREs(%)	> 99.9999998	> 99.99999628	>99.99999981	>99.99999996	>99.99999954	> 99.9999983	> 99.99999898	> 99.99999681
	DXNs(pg-TEQ/g)	0.18	0.034	0.14	0.031	6.2	0.12		
cooling water for machine(L)		15,000							
	DXNs(pg-TEQ/g)	0.016		0.024		0.056	0.056		
powder collection gas (m^3)		0.85	0.92	0.88	0.88	0.92	0.85		
	DXNs(pg-TEQ/g)	0.52	0.5	0.0023		0.00011	0.0024		

3. Toxic by-products:

All pesticides, POPs wastes and the detoxification agency, CaO are changed into fine and activated powder which is safe (the toxic equivalent of DXNs < 1 pg-TEQ/g) perfectly. The organic chlorine compounds are decomposed and changed into the non-chlorine organic compounds. The chlorine were converted to inorganic compounds called $CaCl_2$ or Ca(ClOH). During the detoxification reaction, no exhaust gas and no effluents occur.

4. Uncontrolled releases:

No exhaust gas and no effluents such as harmful organic compounds will be generated. The reaction of detoxification occurs in closed vessels. No generation of CO_2 gas takes place.

5. Capacity to treat all POPs:

PCP, Chlordane, BHC, DDT, Endrin, PCB, Dioxins, Mixture of Pesticides and related POPs wastes, Admixture (Soil, stones, concrete, glass, metal, plastics) polluted by PCB oils and POPs wastes have been successfully treated.

6. Throughput:

6.1 Quantity [tons/day, L/day]
Treatment plant (A-500) is capable of treating 600 kg per day (8 hrs) of transformer oil.

Table 1 Each Vessel sizes and throughput:

Type	E-200	A-500
Diameter of each vessel (inches)	26	40
Volume of each vessel (litres)	250	500
Throughput in tons/day (operation time: 8 hrs/day)	0,3 (approx.1.5 waste drums)	0,6 (approx. 3 waste drums)
Throughput in tons/year (8 hrs/day), 350 days/year	116 (approx.580 waste drums)	219 (approx. 1,100 waste drums)

The capacity can be easily increased by additional two or three treatment plants.

6.2 POPs throughput: [POPs waste/total waste in %]

Radical Technology does not require dilution prior to destruction and therefore the ***full capacity of the plant*** can be used for POPs destruction. The higher the concentration of the waste, the higher the efficiency of the treatment reaction. In case more capacity is needed, two main machines can be installed and operated alternately. As the detoxification reaction occurs automatically and safe in the rotating vessels, the operators can leave the main machine. Two main machines can be operated by the same amount of labor as one machine.

Summary of high-strength POPs treated**:**
・Commercial testing (E-200 Type) with Ministry of Environment, Japan: Soil and Ash contaminated by Dioxin (8,900 pg-TEQ/g) (1999/2000)
・Commercial testing (E-200 type) with Ministry of Agriculture, Forestry and Fisheries, Japan: 91%PCP,95% and 42%Chlordane, 97%BHC Powder, 3% γ -BHC Petroleum Emulsion, 5%DDT Powder, 2%Endrin Powder, 20%PCNB, Admixture of those pesticides powders: (2000/2002)
・Demonstration (E-200 Type) with Sumitomo Heavy Industries, Japan: 51.3%PCB+38.4%trichloro-benzene, Fluorescent Stabilizers contained by 2%PCB, Soil contaminated by 2.4%PCB, Admixture materials contaminated PCB Oil: (2001/2003)

7. Wastes/Residuals:

7.1 Secondary waste stream volumes:
Only powder is generated from the process. The collected powder may be recycled and reused for new materials like high grade concrete after the detoxification. In other words, as this powder is not only safe and fine but also is activated, it can be solidified at room temperature only by mixing with water, become hard as the concrete structure and be formed into any shape, for example Tetrapod. The collected powder is solidified by connecting energy called the molecular bond which is caused by activated atoms or activated molecular. No material at all has to be deposited at landfills!!

7.2 Off gas treatment:
There is no need for off gas treatment. The process takes place in closed vessels and no off gasses are produced.

7.3 Water treatment:
There is no need for water treatment, as no water is produced by the process

7.4 Complete elimination:

Complete detoxification of harmful compounds (e.g. Chlorinated organic compounds) into safe compounds takes place under non-heating, atmospheric conditions and in a closed system by the Mechanochemical principle. While the Pesticides, PCB, and related POPs wastes are treated no exhaust gas and effluents are generated.

Detailed information and treatment examples:

In the separate Annex the following information is given:

Table 1: Technology Overview – Summary Technical Details
Table 2: Overview project experience per technology supplier
Table 3: Overview detailed project information per project - Project name (from Table 2)
Table 4: Utilities Required for E-200 and A500 (Example of Japanese plants)

PART II: Criteria on the Adaptation of the Country to the Technology

Note: This part has to be filled in every time the "suitability" of the technology has to be examined for a certain country situation!!

A. Resource needs:

Radicalplanet Treatment Process consists of three parts, main machine (A-500 type), electric motor and powder collecting equipment. The power source is AC440V, 3ϕ, 60Hz. Electric motor is equipped with AC500kw $\times$1000 rpm, and decelerator (deceleration ratio is 1/14.29). The powder collection equipment consists of a cyclone type and a bag filter type. For this equipment, the power source will be AC 220V, 30kw.
In case no power source is available or power is unreliable in the concerned country, one can operate the treatment plant by a diesel generator.

2. Water requirements:
Radicalplanet Process requires cooling water for cooling the main machine (this stream is recycled through heat exchangers). The cooling water is 10 L/min. stocked in the 10 m^3 tank and continuously reused.

3. Gas volumes:
No gas or no fuel is consumed in the detoxification reaction, because the technology is non-combustion and closed system.
After detoxification treatment, air or inert gas will be used for the safe powder collection. These kinds of gas are used for carrying the safe powder.

4. Reagents volumes:
Example: In order to treat one kilogram BHC Waste, more than 1,50 kg of CaO is needed for detoxification. The suitable ratio of CaO/pesticides will be selected for each case. The additives such as CaO may be added with SiO_2, Al_2O, depending on the desired end-products.

5.Weather tight buildings:
Weather tight buildings are required but have to be ventilated. The main treatment plant and working field will be required to be protected from the rain, strong wind and the direct sun-shine.

6. Hazardous waste personnel requirement:
Personnel require training in the OHS (Occupational Health and Safety) aspects for each waste that is accepted for treatment.

7. Sampling requirements/facilities:
Sampling is required if the composition of the pesticides and the wastes is not exactly known (unlabeled or open drums or admixtures of wastes).

8. Peer sampling:
Independent sampling and analysis has been carried out by the Japanese authorities during all tests.

9. Laboratory requirements:

On site requirements:
For self control of the end products, an optional gas chromatograph plus extraction equipment for PCB analysis in oil and in extracting solvent is needed.
Main instrument:
1.Gas chromatograph plus all related equipment such as:
2.Chromatograph data processing machine and recorder
3.Concentration device
4.Filtration under reduced pressure
5.Closed-loop cooling system
6.Extraction equipment
7.Mix and shake equipment
8.Column chromatograph
9.Separating funnel
10.Dripping funnel
11.Microsyringe, Flask, Desiccator
12.Double-focusing magnetic sector mass spectrometer
In Japan, The last equipment is required to be installed on the treatment site. However, the installation of this equipment will depend on the country's regulatory.

10. Communication systems:
Contrary to other treatment systems there are no online and or remote control systems needed. The system is fool proof.
Mobile network:

Requirements in country:
Dependent on the specific country's regulatory requirements.

11. Number of personnel required: 2
The main operations are a setting the three vessels into the main machine and a releasing them from the machine. After the operation two labours will be operate at the powder collecting equipment.

11.1 Number of Technicians required (skilled labour):
1 skilled labour

11.2 Number of Labourers required (unskilled labour):
1 unskilled labour

B. Costs: Costs given here are only indicative and real costs can only be made if detailed information is available

1. Installation and commissioning costs [EURO]:
Building/purchasing cost
E-200 (one machine with 105 tons/y) Approx:2.8 million EURO
A-500 (one machine with 210 tons/y)Approx :3.3 million EURO
Estimated production period:15months

Pre treatment equipment: Approx: 250.000 EURO
Post treatment equipment: Approx: 300.000 EURO.

2. Site preparation costs [EURO]:
Estimated around 15% of building costs,
Additional costs that cannot be calculated now are for :
1. Power source : 3,300V
/Treatment plant needs 400V (550kw)
These costs will depend on the site situation.
2. Ground condition : must be hard and stable
/The weight of equipment is approx.25tons/m² and as there is a strong force of thrust, hard and stable conditions below the plant are required
These costs will be added to the construction work costs.

3. Energy & Telecom installation costs:
Construction costs:
cannot be estimated
Power source and cable construction costs depend on the distance of the location.
Structure Space needed:
E-200:50m² (in house) (Except :Power source)
A-500: 65m² (in house) (Except :Structure(house))
Working space: 800 m^2(in house)

4. Monitoring costs:
There are no monitoring costs, because there are no-hard noise and no-strong vibration which are below the Japanese limits. The amount of monitoring is dependent on regulatory requirements in the concerned country.

The treatment plant has temperature and pressure measurement equipment inside each vessel. During performance in Japan, temperature was controlled below 150 °C and pressure was controlled below 1.5 kg/cm2 in order to assure a safe operation.

5. Complying costs:
Amount of compliance testing, oversight, etc., will depend on regulatory requirements

6. Reporting costs:
Amount of reporting dependent on regulatory requirements

7. Running costs with no waste:
not applicable

8. Running costs with waste:
Treatment costs per ton:
Electrical costs for:
E-200:1,800kwh/ton=540kw×1.4h/107kg
A-500:3,600kwh/ton=540kw×1.4h/214kg
Annual maintenance cost is included in "Operating & Maintenance Cost 1.5 EURO per kg for Schedule Wastes", except expendables (parts) of the main Machine.

9. Decommissioning costs:
Cannot be estimated

10. Landfill costs:
No landfill costs occurring

11. Transport costs of residues:

There are no residues. Thus no costs for transport of residues. Materials generated from the treatment used as various building materials. See also under Part I under Characteristics of the Radicalplanet Technology.

C. Impact:

1. Discharges to air:
No air emissions during the process

2. Discharges to water:
No water is generated in the process

3. Discharges to land:
None

4. Soil impact (noise etc):
Low noise, and no vibration, because the direction of rotation and revolution are horizontally.

D. Risks

1. Risks of reagents applied:
Very safe agents are applied in this technology, such as CaO, SiO_2 and A_2IO3 which are popular materials in the soil or the earth. CaO bricks are widely used in home and in industries and well managed. As CaO absorbs water and generates heat, CaO should be stored in the packaged dry card board.

2. Risks of technology:
No risks**.** The practical scale machine E-200 type was already operated in Japan and officially granted by the notification on April 1^{ST} , 2004. And the polluted materials never expand, because this process is a closed system and never generate the exhaust gas and effluents during detoxification reaction.

3. Operational risks:
No risks. At the state of emergency the system can be shut down completely. At the earthquake and the 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 continued to be closed tightly.

E. Constructability:

1. Ease of installation / construction of plant:

E-200:
It is easy to construct the treatment plant. It takes about one month and will be performed by the specialists of the producers of the plant.
A-500:
It is easy to construct the treatment plant. It takes about one month. For the other equipments no specialists are needed but such works can be done by local electrical and construction engineers.

Optional Process Equipment

Pre-treatment:
In normal cases, waste in UN approved packages will be supplied to the treatment plant. The acceptance conditions of the plant require, see Part I, A1, sizes of max 10 or 20 kg. In case, materials are delivered in heavy or large drums, repackaging equipment has to be installed additionally.

Post-treatment
Post-treatment equipment can be used to collect the powder and store in drums or other containers. In case one wants to use the powder for other purposes (for example concrete block or wave-dissipating concrete block), such equipment is necessary.

2. Ease of shipping / transit:
The main machine of the Radicalplanet treatment plant is simple, compact and is transportable by trailers. The main machine can be separated into two pieces for transport by large-sized trucks. Photo 2 shows the E-200 treatment plant (total weight 72 tons). If separated, the weight of upper one is approx. 32 tons and of lower one approx. 40 tons.

A. Discharge of the plant at port

C. Plant carried on trailer

B. From ship to trailer

D. To the workshop

Photo 2 (A, B, C, D) Transportability of the main machine E-200 type on a Trailer and shipping (2000)

3. Ease of operation:
All operators of the process must complete a training class in health and safety (see also under Part II A.6), environmental management, and on-the-job operation. Operation is very easy, because the start up and the shut down is completely automatic. Operators will finish the training in a short time. The main works of operators will fill the vessels in the treatment plant and empty the vessels from the treatment plant. After taking off the vessels, their works will be the collection of the powder by the use of powder collecting equipment.

4. Ease of processing :

The process is very robust and reliable. Easy waste handling with filling and emptying of the vessels.
Daily routines: 8 hrs / day are as follows:

First Cycle	Vessel change	Second Cycle	Vessel change	Third Cycle
Rotating (treatment)		Rotating (treatment)		Rotating (treatment)
(1) powder collection		(1) powder collection		(1) powder collection
(2) next vessel preparation		(2) next vessel preparation		(2) next vessel preparation

There are two labors required in this treatment.
No labors are needed during the treatment plant process, but they only work on the powder collection and the preparation of the next vessel preparation during the treatment process.

Vessel change is executed by two labors.
Rotation time is 1.4 hours for high concentration of pesticides. Vessel change time is 1.0 hour, approximately, and three cycles are performed, 8hrs per day.
Rotation time depend on the kind of pesticides, the concentration and the amounts of pesticides. If the concentration is lower the rotation time will decrease. If the rotation time is 1.0 hour, four cycles are performed in 8hrs per day!!.
Routine maintenance usually involves: daily: 30 min.(main plant) after work, weekly: 2 hrs (total equipments). Every half year:12 days (total equipment)

F. Output/generation waste

1. Generated waste (% of input waste)
No waste is generated. See also Part I, A7. under Wastes/Residuals

2. Deposited waste at landfill (% of input waste)
No waste is deposited at landfills. All material can be re-used

3. Waste quality properties (pH, TCLP)
No liquid effluent generated.

**Note: This Technology Specification and Data Sheet (TSDS) does not certify any particular technology, but tries to summarise the state of the art of the concerned technology on the basis of data delivered by the companies or other sources, which have been made available to the author and refers the reader to original documents for further evaluation. Without the efforts below listed technology suppliers it would not have been possible to set up this TSDS. Date: 07.06.2008*

Technology suppliers that have contributed to this TSDS:

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Dr. Kaoru Shimme , http://www.radicalplanet.co.jp/en

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