Waste Oil and Sludge Treatment and Recycling by Manufacturing
Alternative Fuel for Cement Industry

REMATEC Corporation
YASUNORI TANAKA, MITSUYUKI NISHIHARA*, MASATOSHI TANAKA
Today’s Introduction Contents

1. RF Technology (Reclaimed Fuel)
2. SCW Technology (Subcritical water)
3. Illegal dumping waste treatment and management
4. Reconstruction support activities in TOHOKU area (Great East Japan Earthquake and Tsunami Disaster Area)
1. RF Technology
(RF is Reclaimed Fuel for cement industry)
Incineration and land filling are usually chosen for treating these hazardous wastes. Our company has been using RF technology to convert these wastes into a recycled fuel for over 30 years. This recycled fuel is mainly used and highly welcomed in cement factories.
By our original technology and manufacturing process, waste oil, wastewater and solid waste are mixed and used as fuel in cement factories.
Properties of RF ~Reclaimed Fuel~

RF is a material in emulsion state with thixotropy property, its flow behavior such as elasticity and viscosity and their relationship with temperature are theoretically studied in rheology field.

RF’s Properties ⇒ Original technology of REMATEC CORPORATION
Patent No. 3039644
A compound possessing reversible thixotropic property used as an auxiliary fuel for cement pyroprocess

- A material with Thixotropy property
  A thixotropy material has high viscosity at a steady-state, and has low viscosity when introduced to a step change in shear rate or by a mechanical stress.

- Thixotropy is seen in many materials and fluids.
  Tomato-sauce
  Mayonnaise
  Tooth paste
  Paints

Using RF technology, we mix various wastes together and endow them with thixotropy property which displays the natures of preventing oil separating from water or solid separating from liquid while at a steady-state, but when introduced to a step change in shear rate or by a mechanical stress, for example shaking, its viscosity will be decreased and will flow fluently. This feature makes RF easy transportation by pump and pipes.

Copyrights 2012 REMATEC Corporation All rights reserved.
Static microstructure of RF

1. RF bulk
2. Continuous fluid phases
3. Larger dispersion drops (oils and/or aqueous fluids)
4. Smaller dispersion drops (oils and/or aqueous fluids)
5. Solid components to be possible raw material of cement
   5A. Solid components containing possible cement raw materials (~3mm size)
6. Other solid particles
7. Accessory substance (bonding medium)
7A, 8, 9. Microstructures

RF is a compound with some specific viscosity characteristics and is comprised of oil and other liquid components, and solid components containing possible cement materials.

With this structure no phase change occurs, for example, oil separating from liquid, or solid separating from aqueous fluids.
RF, with low viscosity on initial movement, can be transported by normal pipe work and can be used in spray combustion, without any separation of oils and solids (sands, muds, rusts etc.) from aqueous fluids.

Vertical axis is viscosity of RF. Horizontal axis stands for shear rate of RF product.

As shear rate is increased, viscosity of RF will decrease, that results in higher-mobility or flowability of RF and enables easily pipe transportation and spray combustion in cement kiln.
RF’s Application Example
～Effectively used by Cement Factories～

This flow shows the main manufacture process in cement factory. RF is supplied from the middle part of pre-heater and end part of rotary kiln. By manufacturing RF, industry waste are recycled as fuel and raw material of cement. Final treatment is not needed.

Effective utilization in cement factories

Supply Flow

Final treatment for Waste

Reuse and Recycle

Osaka RF Factory (Production capacity 200 ton/day) ⇒ RF Product
Kyusyu RF Factory (Production capacity 192 ton/day) ⇒ RF Product
RF system’s Contribution to Society

Rematec's pledges to society
• Promote industrial waste treatment and recycling by utilizing appropriate and effective technologies.
• Take active steps to help build a sustainable society.
• Actively engage in promoting independent efforts for preventing global warming.
• Promoting practices for preventing environmental pollutions and taking actions positively.

Rematec is admitted as eco first company by Japanese government. Promoting industrial waste treatment and recycling and increasing RF manufacture amount annually are Rematec’s commitment to government.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RF production amount (t)</td>
<td>108,809</td>
<td>93,470</td>
<td>95,536</td>
<td>95,497</td>
<td>90,184</td>
<td>89,440</td>
<td>93,759</td>
<td>95,601</td>
<td>90,061</td>
</tr>
<tr>
<td>Recycle ratio (%)</td>
<td>97.1%</td>
<td>97.3%</td>
<td>97.2%</td>
<td>97.4%</td>
<td>98.1%</td>
<td>98.2%</td>
<td>98.7%</td>
<td>97.9%</td>
<td>97.4%</td>
</tr>
<tr>
<td>Conversion to Coal (t)</td>
<td>74,485</td>
<td>65,277</td>
<td>66,075</td>
<td>66,020</td>
<td>62,138</td>
<td>62,238</td>
<td>65,478</td>
<td>66,315</td>
<td>62,633</td>
</tr>
<tr>
<td>Reduction amount of CO₂ generation (t·CO₂)</td>
<td>187,702</td>
<td>180,086</td>
<td>182,287</td>
<td>182,136</td>
<td>171,427</td>
<td>171,702</td>
<td>180,642</td>
<td>182,950</td>
<td>172,793</td>
</tr>
</tbody>
</table>

This is a cascade type cycle for waste recycle by utilizing RF technology.

Lower carbon emission
Characters of RF Technology

POINT 1
• Our company’s original technology
  ⇒ A wide range of wastes can be treated and recycled
  • Wide range of waste, such as waste oil, waste acid/alkali, sludge or ash can be used as feeding materials of RF.

POINT 2
• No emission of waste gas and discharge of wastewater.
  ⇒ No secondary pollution.
  • RF manufacture is a composition adjustment process by mixing various of wastes.
  • Since there is no need to burn waste in treatment process, no waste gas is emitted.
  • There is also no wastewater generated since almost 100% of the wastes is recycled.
  • It’s an earth-friend recycling system.

POINT 3
• A RF product ⇒ Sold as auxiliary fuel. Final disposal is not needed
  • RF is sold to cement factories to be used as alternative fuel to fossil fuels and the final incineration ash become a part of raw material of cement.
  • Final disposal and management are not needed.
Our Achievements in Plant Design & Construction

Range of Activities
Our experience runs from RF manufacture to plant design and construction and overseas technology transfer. Applications include: construction of our Osaka factory in 1983, Kyusyu factory in 1988, technology transfer to Taiwan in 1993 and to Korea in 1996 and the several plants’ constructions at the Japan’s major cement industry.

- 1983. Our company’s Osaka Factory
- 1988. Our company’s Kyushu Factory
- 1993. Kaohsiung Taiwan
- 1996. Ulsan Korea
- 2008. O Factory at A Major Cement Manufacturer

Copyrights 2012 REMATEC Corporation All rights reserved.
A Case Introduction for Business Expansion in Thailand

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010 October</td>
<td>Attended exhibition in Thailand (EntechPolutec) and arranged a meeting with a major cement company in Thailand.</td>
</tr>
<tr>
<td>2010 November 23th-24th</td>
<td>Went to Thailand visiting the major Cement and Waste Recycle company and carried out feasibility study. Cooperative consultation was conducted between two companies.</td>
</tr>
<tr>
<td>2010 December 15th</td>
<td>Major Cement &amp; Recycle Company of Thailand came Osaka and visited our factory in Kishiwada city.</td>
</tr>
<tr>
<td>2011 March 8th</td>
<td>Went to Thailand to make a discussion with Major Cement Company on the possibility of business expansion and synergy effect on total cement industry causing by RF technology introduction.</td>
</tr>
</tbody>
</table>

Through reciprocal visits and information exchange, business relationship building is going on for fulfilling the technology transfer.
2. Introduction of SCW Technology

(Subcritical water technology)
Subcritical Water’s Properties

Subcritical water is below the water’s critical point. In this area, it has high solubility and hydrolysis capability.

**Ordinary state**
With a low ion product and low OH concentration, organic matter cannot be decomposed.

**Sub-critical water state**
High concentration of OH ion at sub-critical state leads to the decomposition of organic substance.

**Temperature dependence of water’s dielectric constant and ion product at 25MPa**

1. **Point 1**
   - High solubility

2. **Point 2**
   - High hydrolysis capability

Subcritical water is below the water’s critical point. In this area, it has high solubility and hydrolysis capability.
Application 1  Treatment Flow for Nitric Acid Recovery from Waste Pickling

Iron and steel industries use large amount of acid for surface treatment, and large volume of waste pickle acid liquid is being discharged, they are usually treated by neutralization and land filling. We use subcritical water reaction to treat and recycle nitric acid from pickling. Recovered nitric acid is returned to iron and steel factories.

---

**Environmental conservation type technology**

$\text{N}_2\text{O}$, a by-product in virgin nitric acid manufacturing process (a greenhouse gas with about 300 times more powerful than $\text{CO}_2$).

Through the use of recycled nitric acid from waste pickling, we can get 41% CO2 reduction ratio for per ton's nitric acid compared with using virgin nitric acid.

---
We use subcritical water treatment as a pretreatment process for methane fermentation. Long time solubilization and acid formation in traditional type reactor can be shortened after the introduction of subcritical water treatment. Compact treatment system can be easily settled and as easily adopted as distributed energy supply systems in cities or countries.
3. Illegal dumping waste treatment and management
Using superheated steam technology for fire extinction in an illegal waste dumping site

[Back ground]
A project for recovering an illegal waste dumping site

There were several fire burning spots in the dumping waste

It was too difficult to extinguish the fires only by water inject

Support Request

We proposed the treatment plan of using the superheated stream technique

Fire extinction were conducted based on the stream diffusion model and thermo-fluid analysis results.

[Fire extinction by superheated steam]

- Stream has higher diffusivity than water.
- Air is substituted by stream injected from the bottom of burning waste layer and fire extinguished fire by suffocation function.
- 24 hours continuous operation were conducted for about 3 weeks.
- Results were confirmed through monitoring of temperature and oxygen concentration data.

Diagram: Injection of stream with specification and process description.
Illegal dumping in Aomori and Iwate Prefecture
Illegal dumping waste amount: reached to 1,100,000 m$^3$
Types of waste: a wide variety of waste including combustion residue, waste oil, sludge, waste food, etc.
Illegal dumping vendors: over 12,000

Role of Rematec Corporation
We proposed the treatment plan to Iwate Pref.
Illegal dumping waste were managed and recycled.

Current situation
280,000 ton of waste in Iwate and 750,000 tons of waste in Aomori were clearly removed now.
These waste were sorted and treated in the following ways.

- Solid waste (sludge) • Liquid waste
  ⇒ 230,000 ton of wastes were treated in Ofunato factory of Taiheiyou Cement Corporation (81.2% of total quantity)
- Waste plastics, sludge, waste metals, sludge containing high salt concentration
  ⇒ Dowa Eco-system Co., Cleaning Centre of Kamaishi city, Iwate North Clean Co., etc.
4. Reconstruction Activities in TOHOKU area

Disaster waste by Tsunami
75,6000 ton in Ofunato city
1,016,000 ton in Rikuzen-Takada city
(Data Source: HP of Ministry of the Environment of Japan)
This photo was taken one week after the Tsunami, the day we went to inspect this area. It records the damaged houses, disaster debris, and other great amount wastes.
Disaster related waste by Tsunami
75,6000 ton in Ofunato city and
1,016,000 ton in Rikuzen-Takada city
Treatment Flow for Disaster Waste

Due to the strict effluent discharge standards in Ofunado city, water treatment process was designed and conducted for meeting these standards.

Disaster waste → Sorting → Crushing → Washing (Salt removal process) → Recycling (Energy and raw material for cement manufacture)

Waste water treatment → Treated water → Effluent

Photo is our treating site in Ofunato city.
Dynamic state analysis for washing fluid in salt removal equipment

Fluent analysis for washing fluid was conducted for getting an optimum washing parameters. 3D analysis for flow line and the dynamic state analysis for washing fluid in salt removal equipment are illustrated here. The important point is salt concentration difference between wood chips and washing water.

This figure shows the mass fraction of water and air in washing equipment.

This fig. shows the cross section distribution of fluid speed while rotating at 30rpm. Vector represents flow direction.
Coagulant development for effectively treating colored wastewater from wood washing

A coagulant for effectively removing colored substances eluted from wood washing process was developed and applied in the treatment facility. Photos illustrate the colored washing solution and decoloration effect of this coagulant.
Disaster waste are transported to scrubber by conveyors.

Conveyors

Wood chips after salt removing and dewatering

Scrubber

Water treatment process
Disaster waste (Before salt removing)  Raw material for cement use (After salt removing)
Business Expansion Imagination

UNEP-IETC
April 16-18, 2012
Technology Transfer Process

Japan
Government

Overseas Countries
ODA
CDM

Host countries
Government

Local company
Local company
Local company

Rematec Corporation

Discussion

Tech. Association

Information Collection

Copyrights 2012 REMATEC Corporation All rights reserved.
Thank you for listening!!

We would like to provide technical assistances to developing countries for promoting wastes recycling technologies’ widely application.

Through the application of ODA or CDM projects in your government, it is possible to fulfill technology transfer between countries and companies.

For the further discussion, please contact us by following email address or company’s homepage.

info@rematec.co.jp
http://www.rematec.co.jp/