

# New Solution for Radioactive Waste Treatment by Multiple Fermentation (EMBC-FT)

複合発酵法(EMBC-FT)による新しい放射性廃棄物  
処理技術について

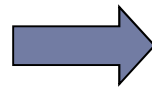
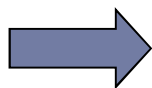
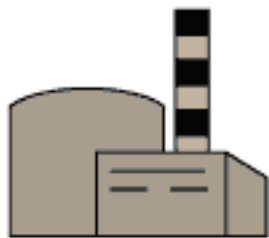
Takashima Institute of Development Technology  
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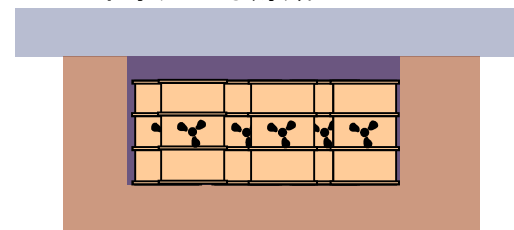
# How to deal with “Radioactive Waste Problems” so far?

## 放射性廃棄物問題へのこれまでの対応

Ex) low-level waste  
例) 低レベル廃棄物



Semi-permanent Storage  
半永久的な貯蔵



Emission from nuclear power plant  
原子力発電所から排出



Separation / Concentration  
分離、濃縮



Tightly sealed  
密閉容器に封入



Wait for natural radiation decrease  
貯蔵し、自然減少を待つ

Safety management  
保管中の安全管理

Storage space procurement  
保管場所の確保

Storage cost accumulation  
保管にかかるコスト

**Is it a real solution??**  
廃棄物問題の解決??

Conventional standpoint for wastes  
廃棄物に対する従来の見方

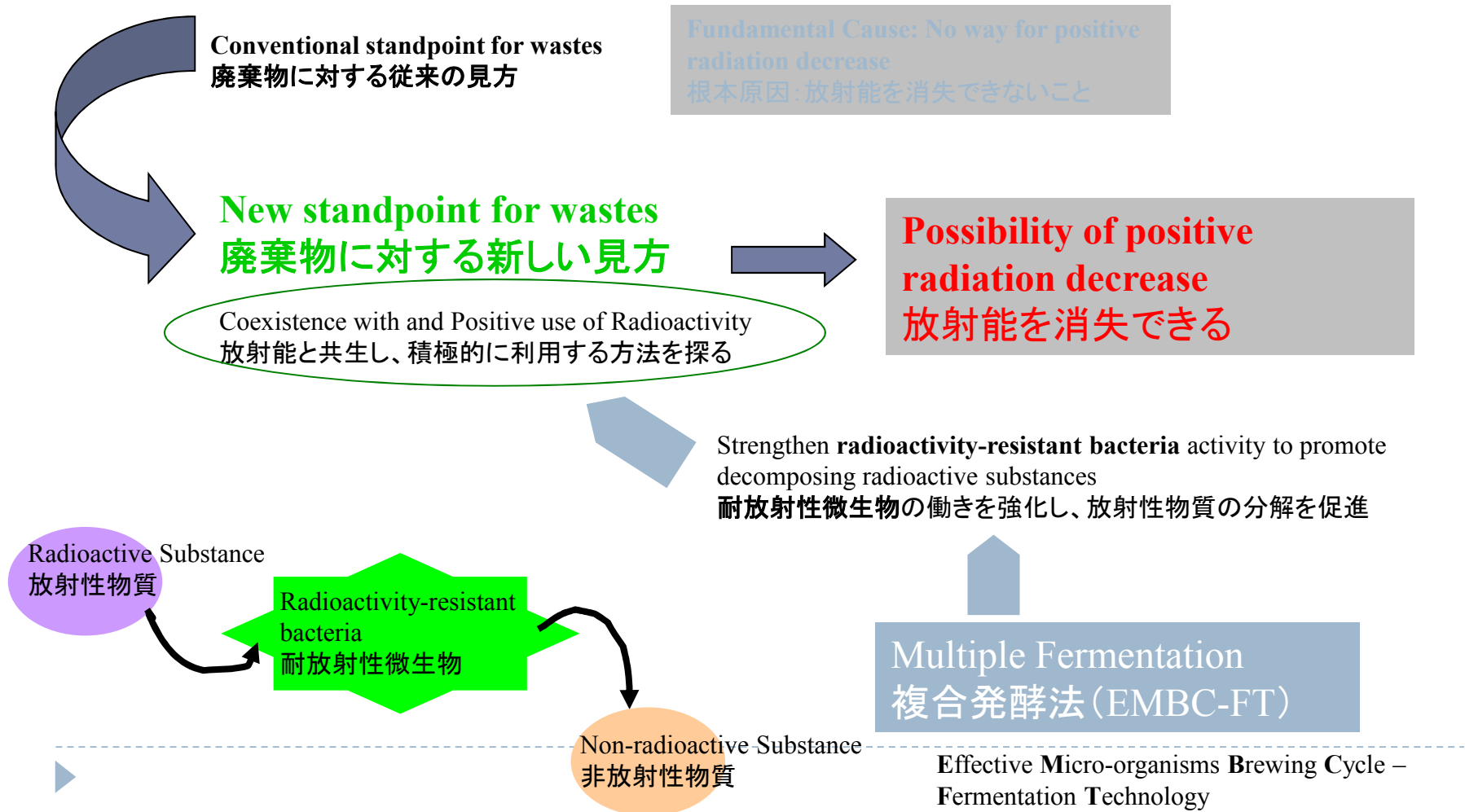
Impossible to decrease radiation  
放射能レベルは操作不可能



Separation & Natural decrease  
隔離して、自然減少を待つ

Fundamental Cause: No way for positive  
radiation decrease  
根本原因: 放射能を消失できないこと

# How should we deal with “Radioactive Waste Problems” from now? 放射性廃棄物問題に対し、今後どう取り組むべきか



# PRESENTATION PLAN

今日の発表内容

- 1 What is “Multiple Fermentation(EMBC-FT)” ?  
複合発酵(EMBC-FT)とは
- 2 Application to low-level radioactive waste  
liquid treatment  
低レベル放射性廃液処理への応用
- 3 Process and Results of waste liquid treatment  
test in Republic of China  
台湾での廃液処理実験の内容と結果



Understanding unlimited possibility of EMBC-FT application  
複合発酵(EMBC-FT)応用の無限の可能性がわかる

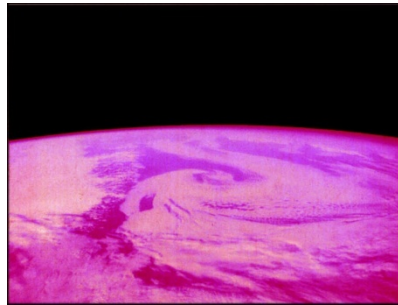
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What is “Multiple Fermentation(EMBC-FT)” ?  
複合発酵 (EMBC-FT)とは

# The earth history and Micro-organic activity

## 地球の歴史と微生物の働き

About 4 billion years ago  
誕生当時(40億年前)の地球



Methane, Ammonia, Hydrogen, Steam  
メタン、アンモニア、水素、水蒸気

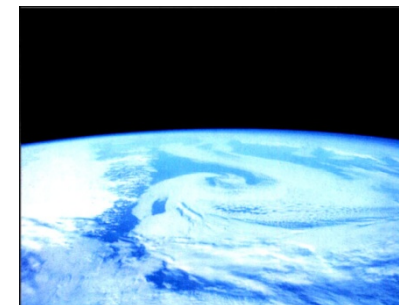
Sulfuric acid, Nitric acid, Heavy metals  
硫酸、硝酸、重金属成分

UV, Electron ray, Gamma ray, X-ray  
紫外線、電子線、γ線、X線

About 600°C



Present  
現在の地球



Oxygen, Nitrogen, Steam, Ozone  
酸素、窒素、水蒸気、オゾン

Salt, Water, Minerals  
塩分、水、ミネラル分

Visible radiation  
可視光線

About 15°C

Atmosphere 大気主成分

Marine 海洋主成分

Comic rays 降下宇宙線

Ave. Temperature 地表温度

**Q) What have changed ancient polluted world into the present for 4 billion years?**

40億年かけて汚染物質世界を変えてきたものは何？

⇒ **A) Activities of the micro-organisms that are suitable for the polluted world(That is Natural Self-cleaning Effect).**  
汚染物質世界に住むのに適した微生物たちが増殖し、自然の自浄作用として物質を変換



EMBC-FT theory's origin :  
EMBC-FT理論の原点:

**Can we use this power effectively?**  
この力をうまく利用できないか？

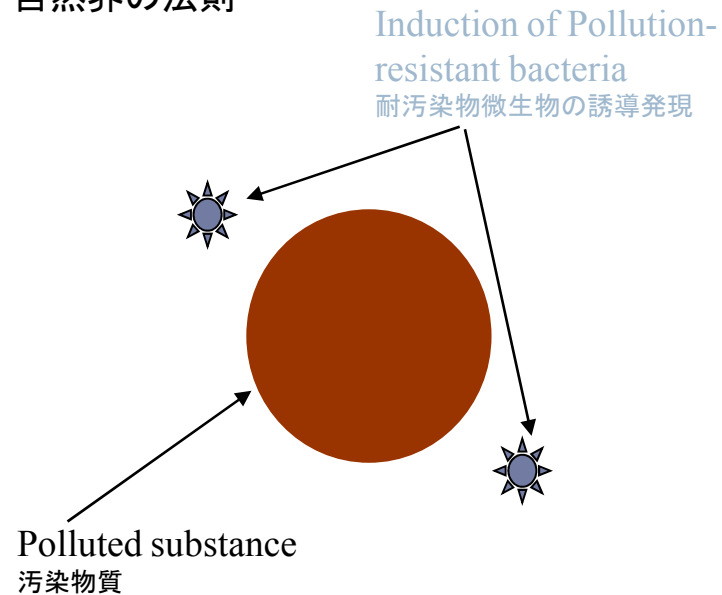
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What is “Multiple Fermentation(EMBC-FT)” ?  
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# Induction of desirable micro-organic ecosystem by EMBC-FT

## EMBC-FTによる好ましい微生物生態系の誘導

**Law of the nature**  
自然界の法則



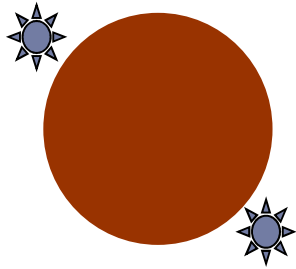
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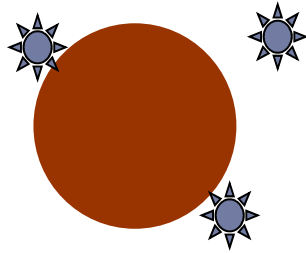
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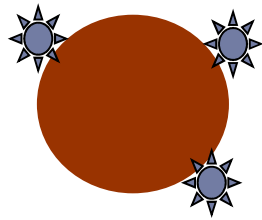
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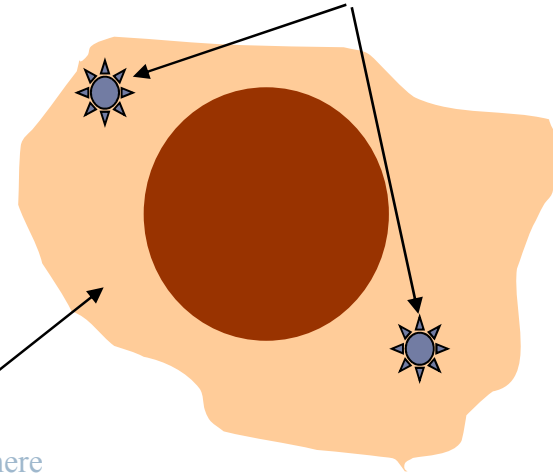
Require long term to decompose  
分解に長い期間が必要

**EMBC-FT condition**  
複合発酵状態

Pretreatment for  
EMBC condition  
複合発酵誘導のため  
の事前処理



Induction of Pollution-  
resistant bacteria  
耐汚染物微生物の誘導発現



EMBC-FT atmosphere  
複合発酵雰囲気



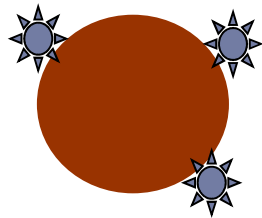
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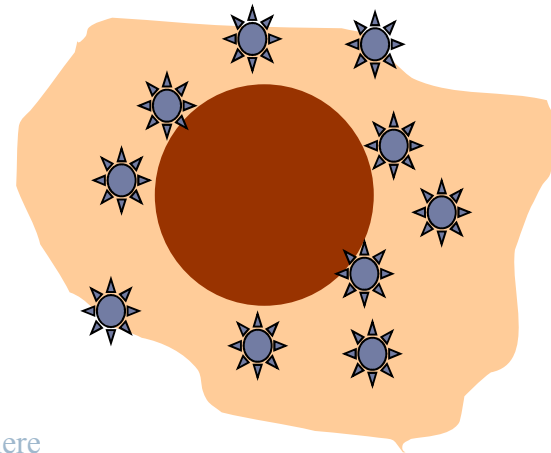
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**Law of the nature**  
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Require long term to decompose  
分解に長い期間が必要

**EMBC-FT condition**  
複合発酵状態



EMBC-FT atmosphere  
複合発酵雰囲気

Almost zero at micro-organic death rate  
微生物の死滅率をほぼゼロ化



Infinite proliferation  
無限増殖が可能

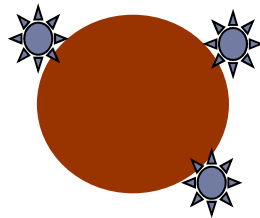


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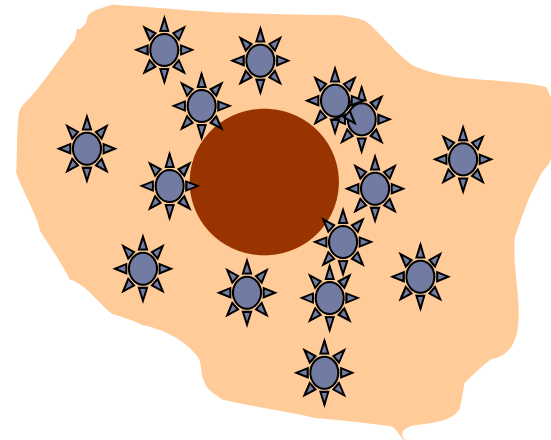
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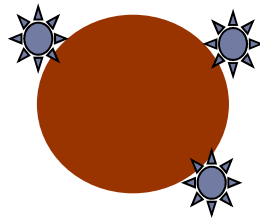


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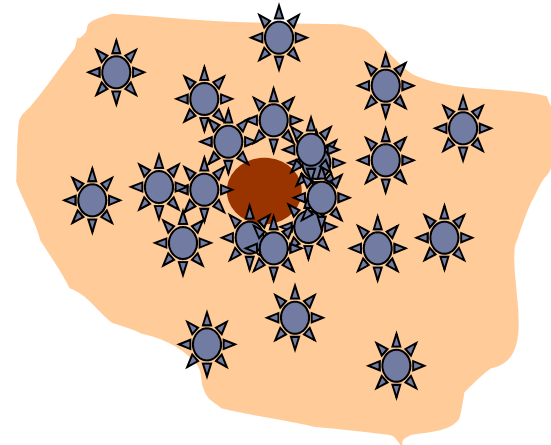
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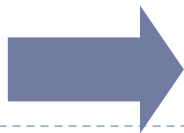


Require long term to decompose  
分解に長い期間が必要

**EMBC-FT condition**  
複合発酵状態

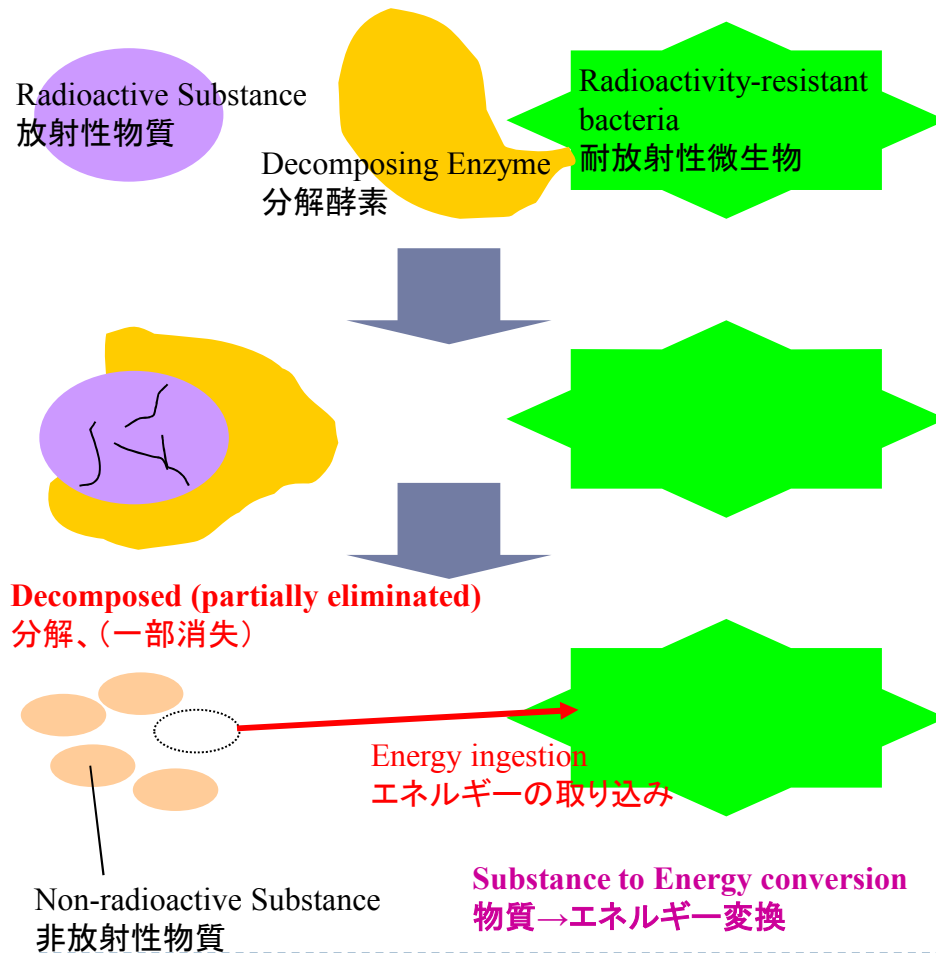


**Promote to decompose rapidly**  
分解がすみやかに進行する



**EMBC-FT enables ultimate increase in the natural self-cleaning effect**  
EMBC-FTは、自然の持つ浄化作用を極限まで高める方法である。

## Activities of radioactivity-resistant bacteria 耐放射性菌の活動



Examples of Radioactivity-resistant bacteria  
耐放射性菌の例

Genus	Type
<i>Acinetobacter</i>	radioactivity-resistant bacteria
<i>Arthrobacter radiotolerance</i>	radioactivity-resistant bacteria
<i>Bacillus cereus</i>	radioactivity-resistant bacteria
<i>Bacillus pumilus</i>	radioactivity-resistant bacteria
<i>Bacillus subtilis</i>	radioactivity-resistant bacteria
<i>Candida albicans</i>	radioactivity-resistant yeast
<i>Candida ciferrll</i>	radioactivity-resistant yeast
<i>Candida krusei</i>	radioactivity-resistant yeast
<i>Chroococciopsis</i>	radioactivity-resistant cyanobacteria
<i>Clostridium botulinum</i>	radioactivity-resistant bacteria
<i>Clostridium perfringens</i>	radioactivity-resistant bacteria
<i>Cryptococcus neoformans</i>	radioactivity-resistant yeast
<i>Deinobacter grandis</i>	radioactivity-resistant bacteria
<i>Deinococcus proteolyticus</i>	radioactivity-resistant bacteria
<i>Deinococcus radiodurans</i>	radioactivity-resistant bacteria
<i>Deinococcus radiophilus</i>	radioactivity-resistant bacteria
<i>Deinococcus radiopugnans</i>	radioactivity-resistant bacteria
<i>Dunaliella bardawil</i>	radioactivity-resistant green algae
<i>Erwinia</i>	radioactivity-resistant bacteria
<i>Escherichia coli</i>	radioactivity-resistant bacteria

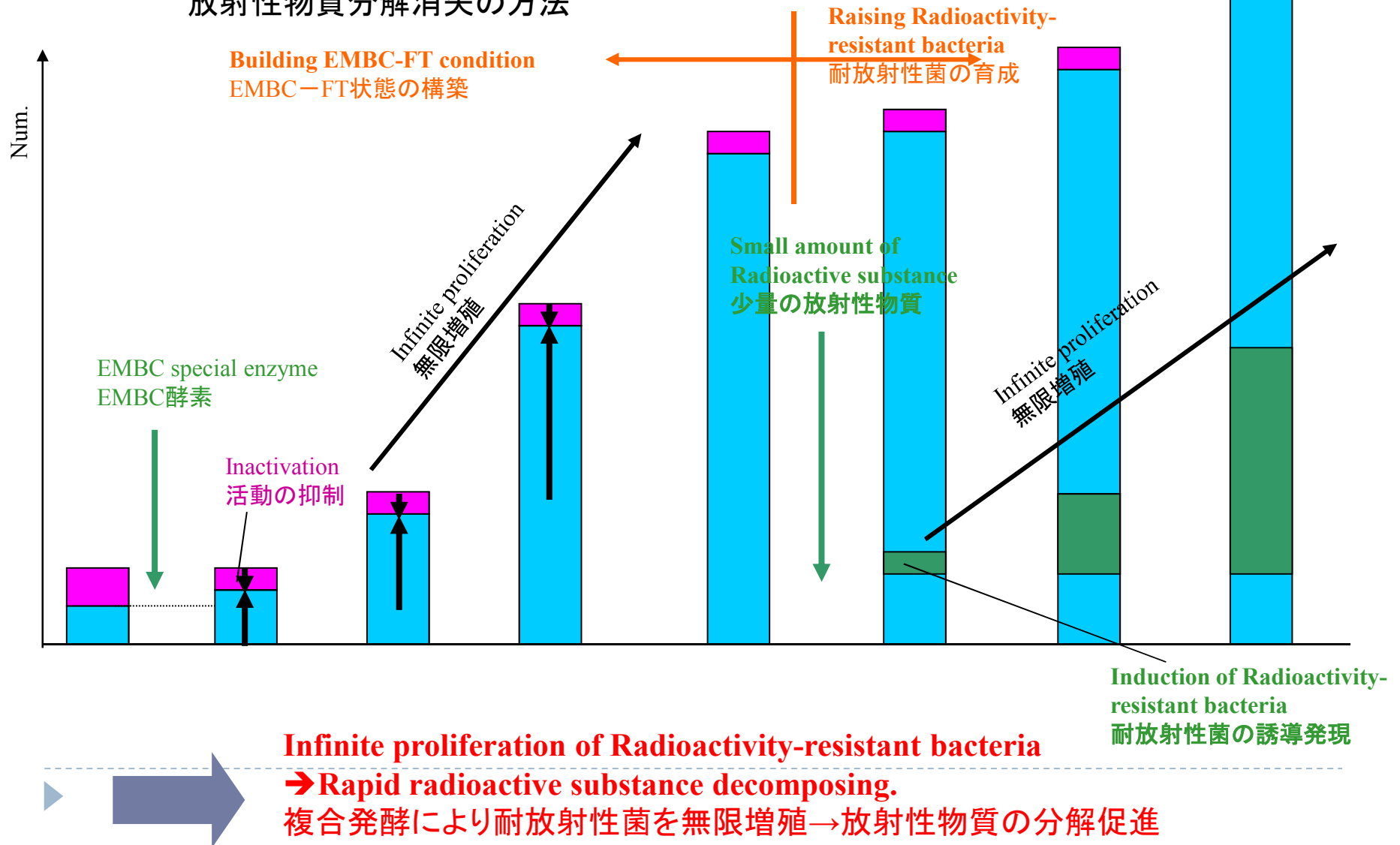
2

Application to low-level radioactive waste liquid treatment  
低レベル放射性廃液処理への応用

## Process to eliminate radioactive substances 放射性物質分解消失の方法

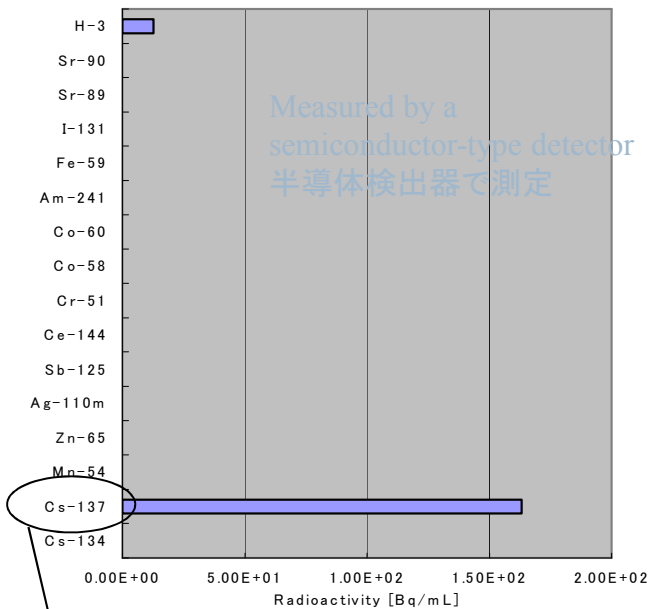


## Process to eliminate radioactive substances 放射性物質分解消失の方法



# Test conditions 実験条件

Nuclide in the waste liquid  
廃液に含まれる核種

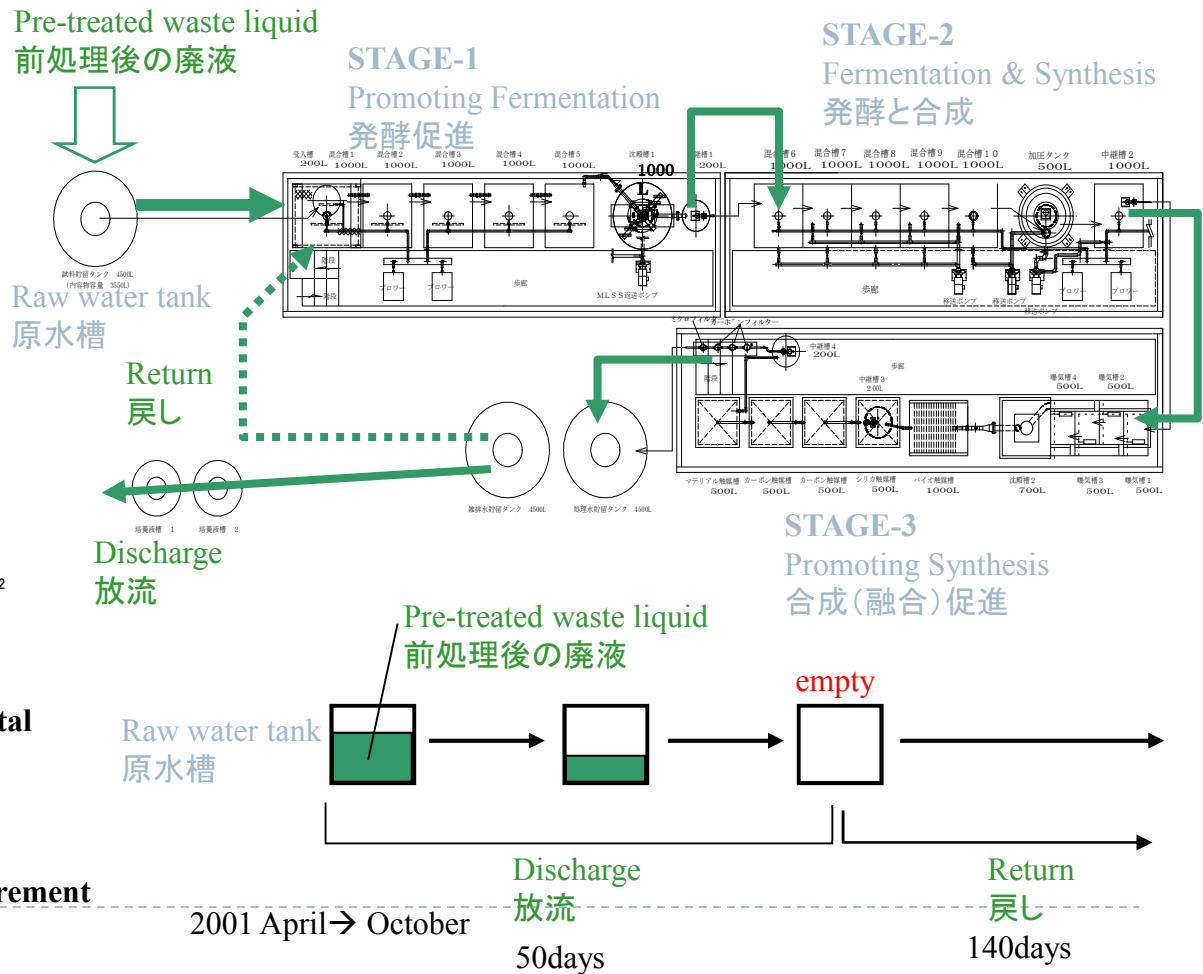


Measured by a semiconductor-type detector  
半導体検出器で測定

Cs-137 radioactivity occupies over 90% of total  
セシウム137の放射活動が全体の9割以上

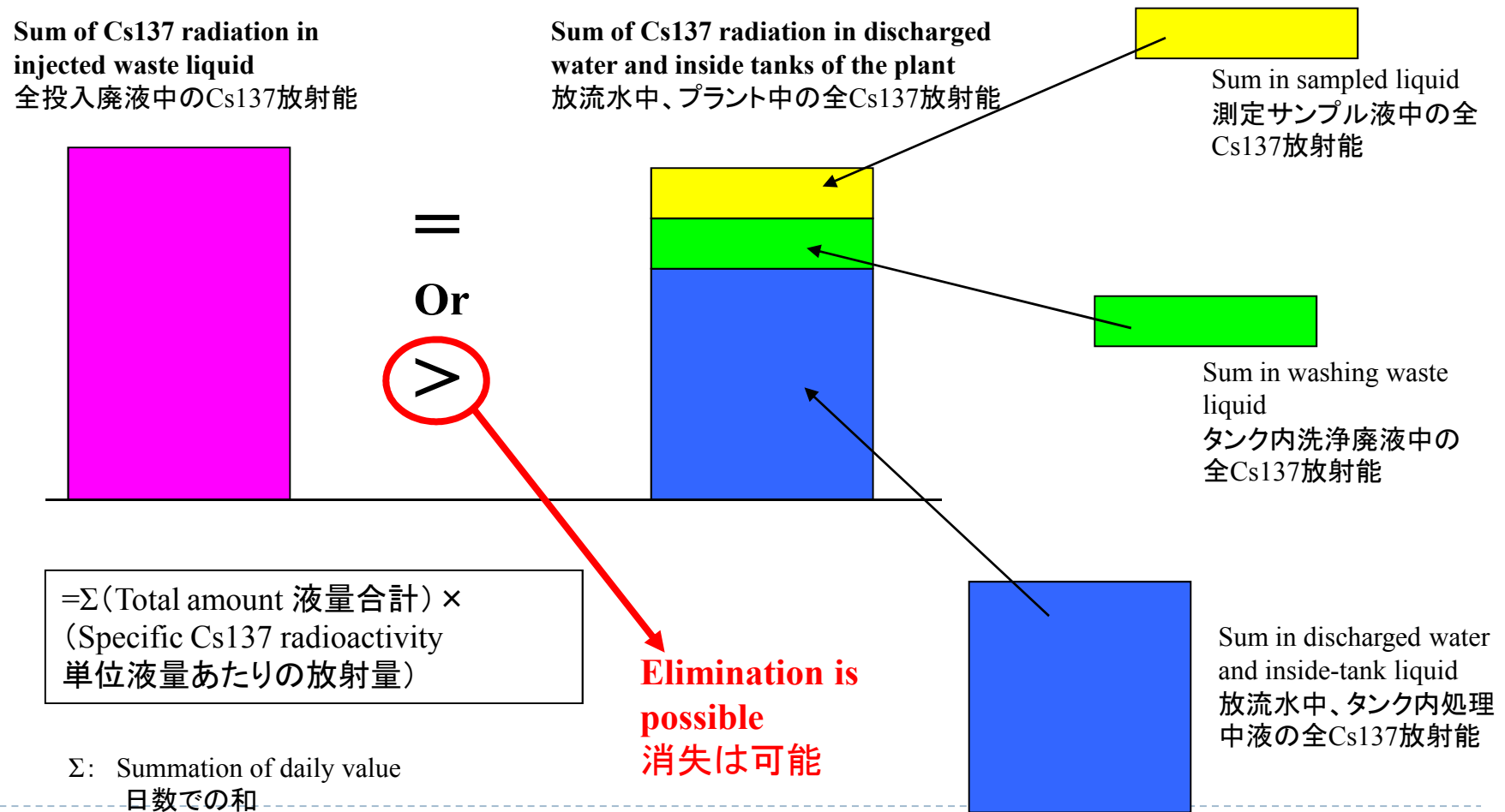
Estimate total radioactivity by Cs-137 measurement  
セシウム137の値をほぼ全体値とみなす。

Processing flow in the pilot plant  
処理プラントでの流れ





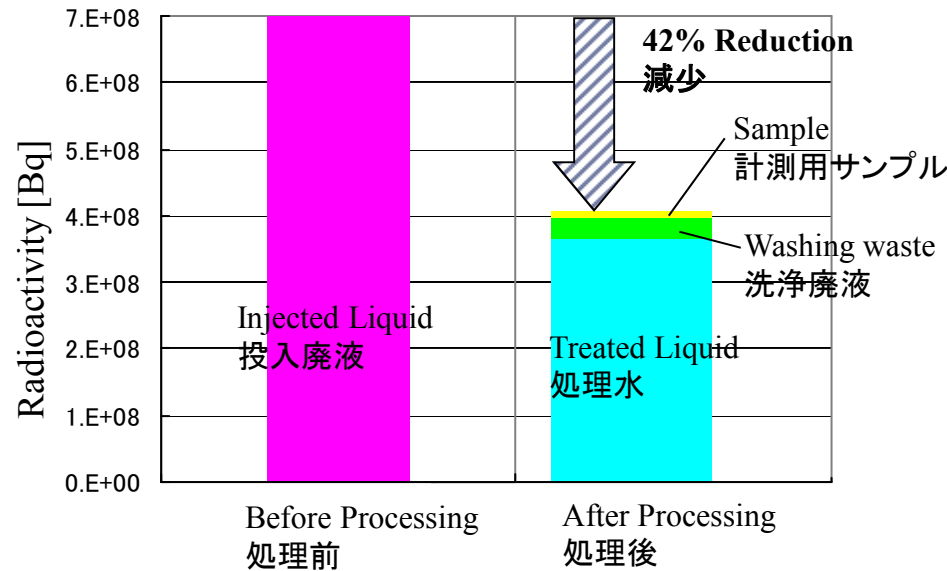
## Demonstration method of treatment effect 処理効果の検証方法



## Test results 実験結果

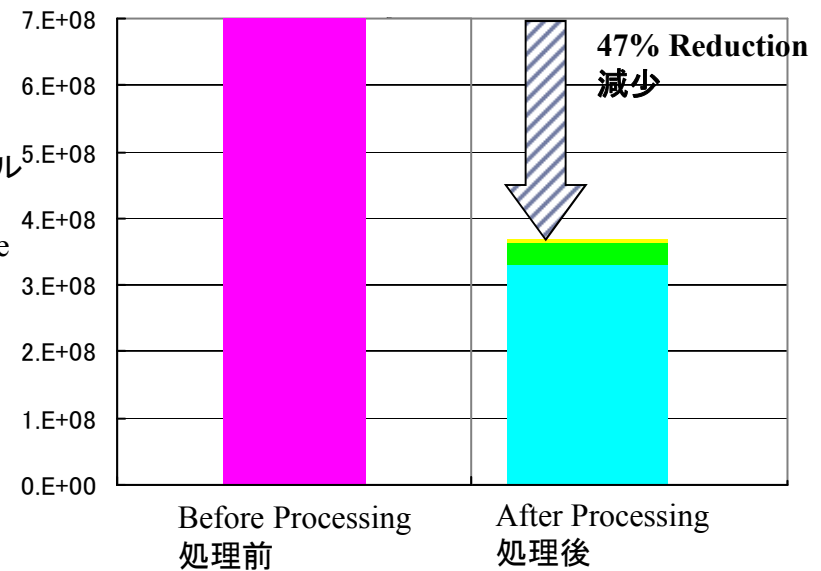
### CASE-1

Estimating total liquid volume from tank drawings  
各槽内の水量を図面から算出した場合



### CASE-2

Measuring total liquid volume with a measurement tank  
各槽内の水を計量槽に移して測定した場合



**EMBC-FT processing enables to decompose and eliminate 42-47% of radioactive substances**

EMBC-FT処理方法により放射性物質量の42~47%を分解消失

# CONCLUSION

## まとめ

1

What is “Multiple Fermentation(EMBC-FT)” ?  
複合発酵(EMBC-FT)とは



**Effective method to increase the natural self-cleaning effect ultimately**

微生物による自然の自浄作用を極限まで高める手法

2

Application to low-level radioactive waste liquid treatment  
低レベル放射性廃液処理への応用



**Decomposing radioactive substances using infinite induction and proliferation of radioactivity-resistant bacteria**

耐放射性菌を誘導発現、無限増殖させることで放射性物質を分解

3

Process and Results of waste liquid treatment test in Republic of China  
台湾での廃液処理実験の内容と結果



**Over 40% of radioactive substances have been eliminated.**

廃液中の放射性物質量の4割以上を分解消失



**New solution approach to various difficult problems by EMBC-FT application**  
複合発酵(EMBC-FT)を活用する、各種難問題への新しい解決アプローチの存在