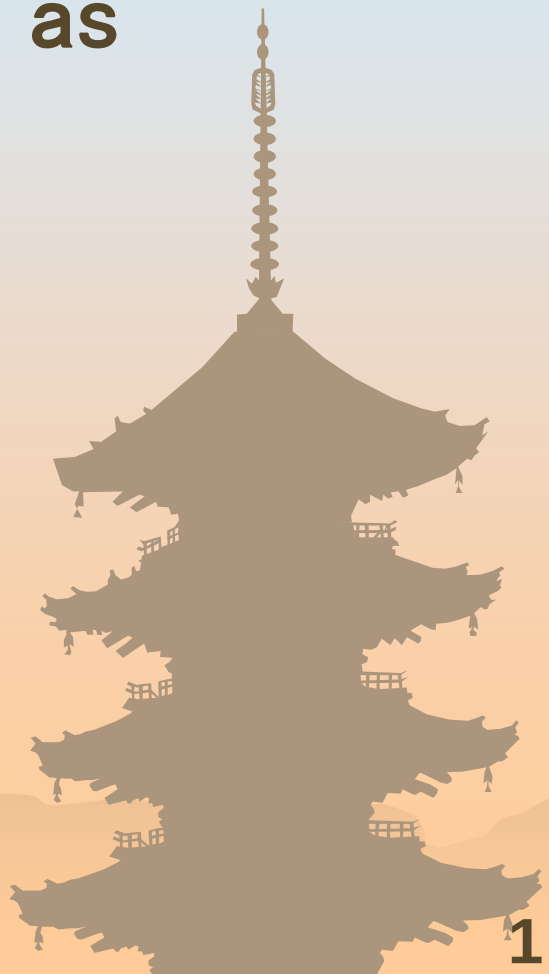
Kyoto – Japan

Usage of Recycled Cooking Oil as an Alternative Fuel for Transportation



Environment Bureau

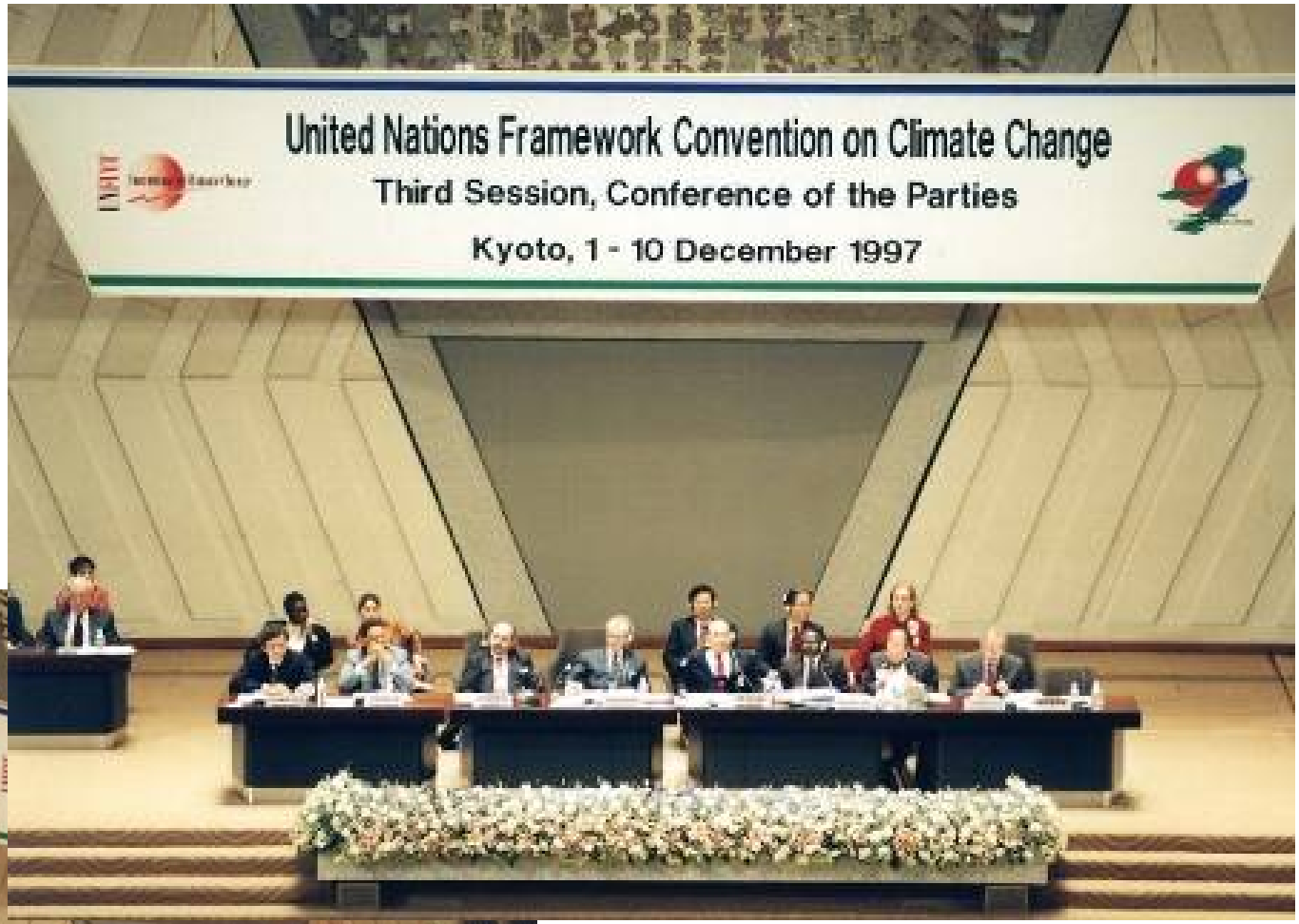
City of Kyoto, Japan

What is Biodiesel Fuel Production Project in Kyoto

Reclaimable, alternative fuel for light oil from waste edible oil.

Resource recycles of waste edible oil from general households as well as restaurants and cafeterias .

What promted biodiesel fuel production in Kyoto is …



Kyoto Conference on the Prevention of Global Warming（COP3）held in December 1997

Estimated potential waste edible oil recovery and BDF usage rate per year in Kyoto

	Estimated potential recovery	annual usage	utilization ratio
Discharged from general household	about 1,500Kℓ	about 150Kℓ	about 10%
Discharged from restaurants and cafeterias	about 3,000Kℓ	about 1,500Kℓ	about 50%

Placement of collecting points of waste edible oil from households and progress of collecting volume of the oil

The aim in placement of the collection points is 2000 points (one point for each 300 families)

Partnership with citizens, companies and municipality

⇒

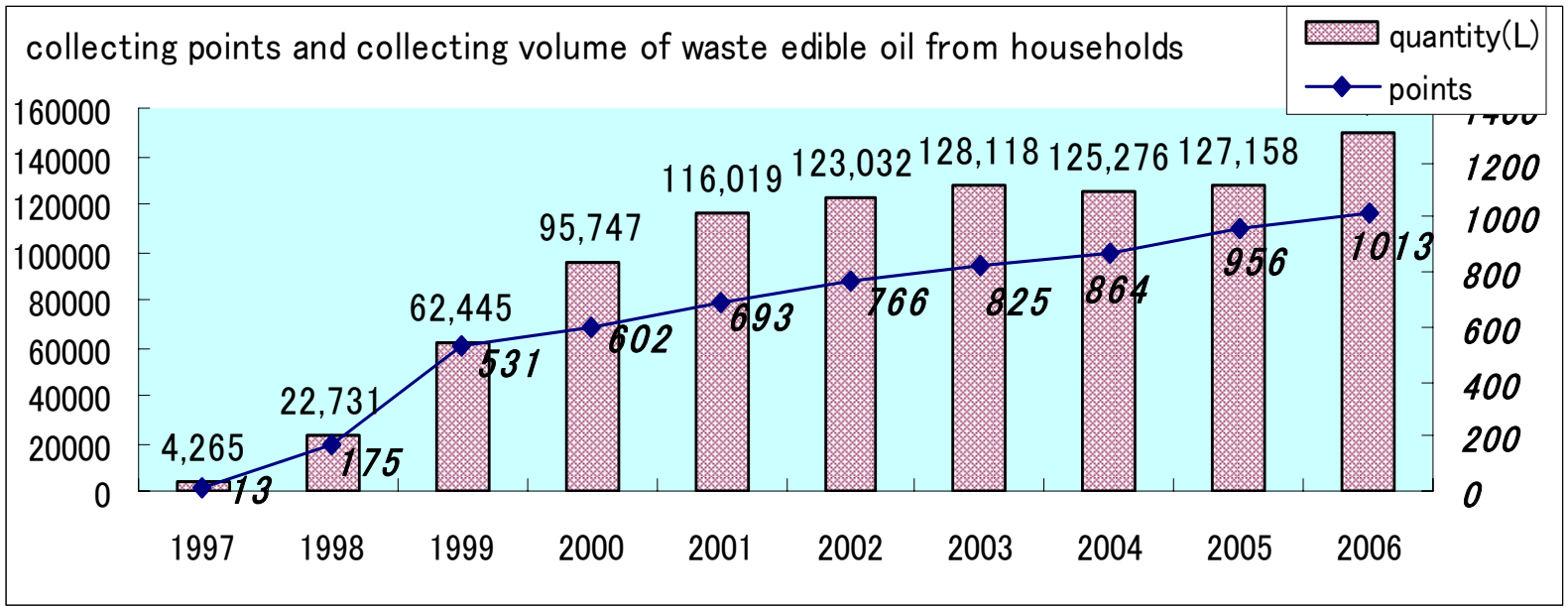
Citizen who have a keen awareness of environmental issues

Neighborhood Garbage-reduction Promotion Councils (model tests collecting) 13Points

bush telegraph of citizen who have a great zeal for environmental matters

Expand to local communities, regional women societies etc. 1013Points.

Waste edible oil from households in Kyoto has been recovered as a grass-roots activities



Collecting system : Polyethylene collection–tank system

Collecting system : Permanent point and drum system

Issues on Citizen collection

① Drop in increasing rate of collecting points

⇒ Foundation of subsidy system

② Drop in increasing rate of collecting oil

⇒ Setting up permanent collecting points

③ Decrease of opportunity to make tempura at home

Declining birthrate and a growing proportion of elderly people. Increase of chance to eat snack

⇒ Tap new collecting targets

④ Protection of personal information and exhibition of the collecting points

⇒ Confirmation of public consent for exhibition

Kyoto Municipal Waste Edible Oil Fuel Production Facility 5000 liters/day

Supporting Project of Ministry of Environment

Panorama of Production Process

Three-tank construction

（1．Pretreatment tank　2．Reaction and separation tank　3．Refinery tank）

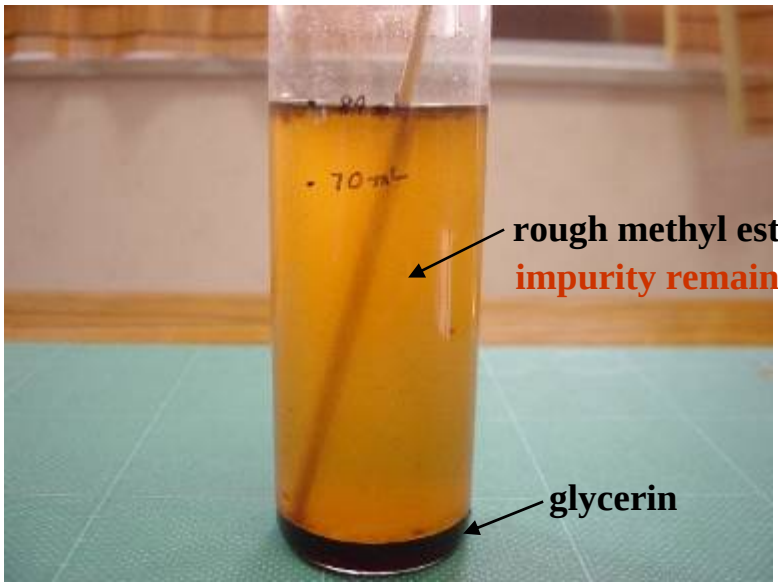
It is easy to produce Biodiesel Fuel, but …

Raising reaction rate（high esterification）and high removal of impurity or water is essential !

Experiment set

methanol input

double-boil 60℃
mixture agitation



reactive separation

to use skimming as is !

fuel filter clogging

remained glycerin and potassium (**catalyst**)⇒stains fuel filter and engine inside

highly viscous accumulated matter (bottom of TCV hole)

Influence with the use of biodiesel fuel to diesel vehicles

1. Influence to fuel supply system

① fuel element clogging ⇒ glycerin、Kalium

② fuel pipe corrosion⇒ oxidation (free fatty acid)
methanol

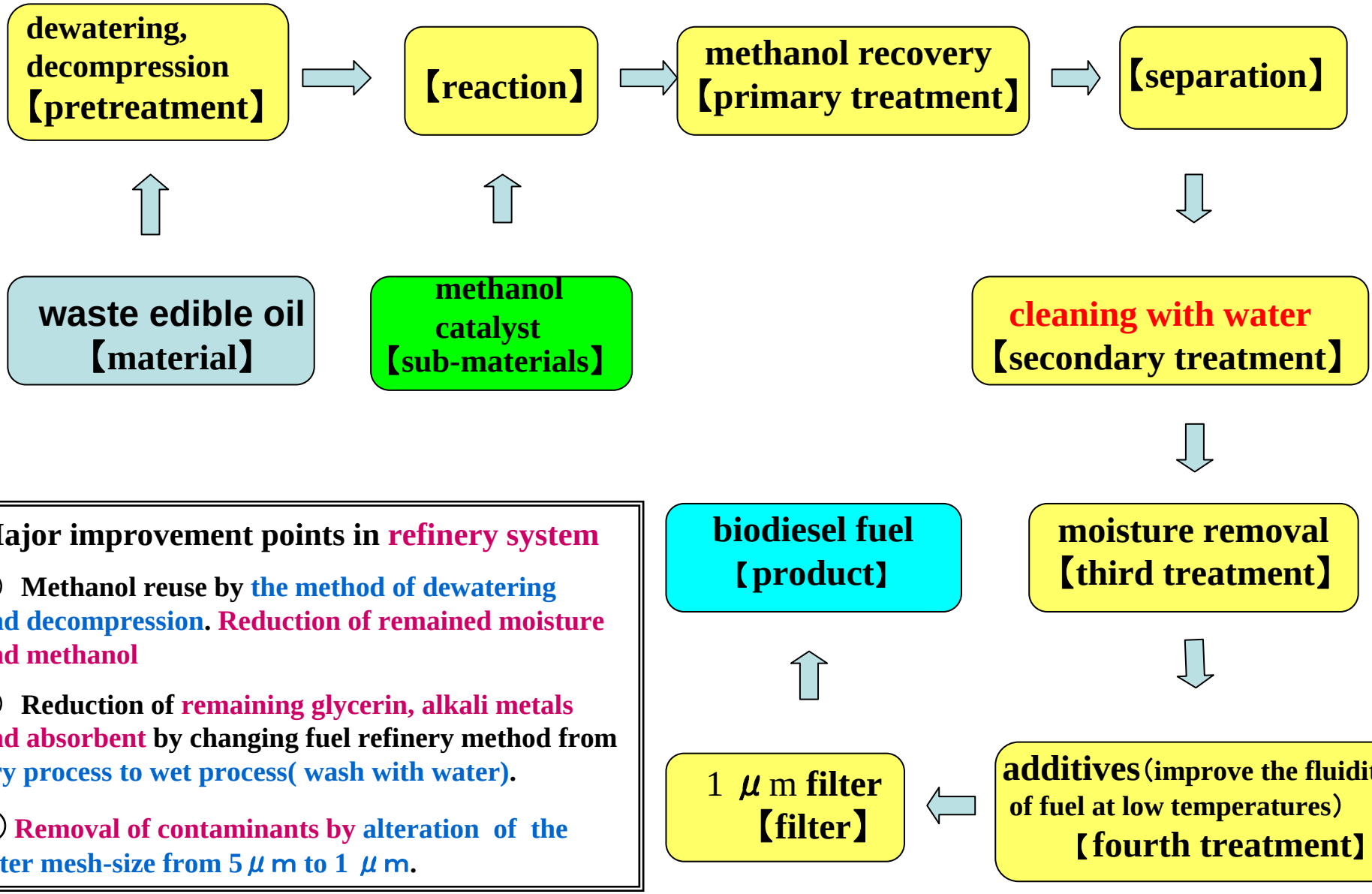
③ swelling of fuel hose and packing, degradation
⇒ esters

2. Influence to fuel injection system

① stick and deposit generation in injection nozzle
⇒ unreacted oil (mono、di、tri-glyceride)

② defective actuation of injection pump
⇒ glycerin、Kalium

Major improvement points in production system of Biodiesel fuel



Major improvement points in refinery system

① Methanol reuse by the method of dewatering and decompression. Reduction of remained moisture and methanol

② Reduction of remaining glycerin, alkali metals and absorbent by changing fuel refinery method from dry process to wet process(wash with water).

③ Removal of contaminants by alteration of the filter mesh-size from 5 μm to 1 μm.

Change of properties with the alteration to fuel production method—Establishment of original fuel standard—

Process	①beginning—dry refinery–	②improvement–dry refinery–	③improvement–wet refinery–	④facility—wet refinery–	temporary standard of Kyoto city
Feature of process	Activated white earth	Pretreatment (filtration, dehydration)、activated white earth・silica gel column、centri-fugation	Methanol recovery、cleaning with water、aftertreatment (dehydration、pour—point depressant)	Two—stage ester conversion reaction、Two-stage hot-water cleaning	
Object year	1998・1999	2001	2002	2004	
Water content(ppm)	490～735	649～800	300	158	500
Flash point(℃)	51～64	32～33	198	172	100
Sulfur content(ppm)	2～	2	1	3	10
Mono—glyceride(%)	No Measurement	0.57～0.76	0.82	0.73	0.8
Di—glyceride(%)	No Measurement	1.17～1.26	1.31	0.16	0.2
Tri—glyceride(%)	No Measurement	10.16～11.28	7.94	0.03	0.2
Free glycerin(%)	No Measurement	0.059～0.300	0.005	0.006	0.02
Methanol(%)	No Measurement	0.76～0.80	＜0.01	0.012	0.2
Alkali metal(mg/kg)	No Measurement	101	2	2.6	5
Remarks		Ash content Decreasing	Enhancement on residual inpurities removal such as remaining glycerin	Reduction of un-reacted oil、high esterifi-cation	

Measure to fuel hoses of biodiesel fuel vehicles

Fuel hoses and packing⇒ Alteration to string-slot rubber or fluorine rubber

Use of biodisel fuel to city buses and garbage-collection trucks

City buses (about 95)
B20 (containing 20% BDF)

Garbage-collection trucks
(about 220) B100 (100%)

The use of roughly 1.5 million liters of biodiesel fuel per year contribute to a reduction in carbon dioxide emissions by about 4000 tons per year

The present conditions and problems of influence to vehicle

Distinction of Biodiesel fuel

① Vulnerable to low temperature of the winter season

→ improvement on low temperature liquidity is needed

② Easy to be oxidized（occurrence of gum-like product materials）

→ Security of oxidation stabilizer is needed

③ Investigation of long-term influences

→ Continuous confirmation on corrosion of the pipe inside is needed

Mr. Ukyo Katayama has completed Dakar rally using biodiesel fuel (B100) of Kyoto city

~ goal on the 21st of Jan. The general ranking was the 68th place (19th place in class) ~

After the rally, the fuel remained in the fuel tank or in the drum was collected as a sample and taken back. The effects of the fuel additives was analyzed and investigated to make further quality improvement of biodiesel fuel.

Details of BDF Production expenses in 2005 fiscal year

(yen / liter)

Item of expenses		Amount of money
Management expenses		80
	Purchases cost for waste edible oil	29
	Purchases cost for methanol and catalysts	10
	Water bill (electricity supply is covered by in-house power generation)	2
	Expenses for quality check	8
	Expenses for quality improvement research	8
	Other running costs	23
Depreciation of facilities		20
Total		100

The production expenses is 100 yen per liter including the depreciation of facilities (management expenses is 80 yen per liter). It is almost equal to the light oil price.

Mayor of Kyoto was designated as the chairperson

Establishment of the national conference for promotion of biodiesel fuel use

The meeting was held in March, 2007. at Minami Aoyama hall, Tokyo

Actions for promotion of biodiesel fuel use

① Guideline and quality standard for safe and appropriate use of the fuel

② Study for promotion of the fuel use on a system side like tax abatement

“Kill five birds with one stone” effects and meanings

① Recycling of waste edible oil
② Cut CO2 emission (about 4000tons per year)
③ Clean the car exhaust gas
(reduce CO、HC、PM、Sox)
④ Practical environment education
⑤ Activation of local community