Aiming at the Life Performance and Enhanced Technology of Recycling Asphalt Pavement in Japan

Kazunari HIRAKAWA
Taisei Rotec Corporation
Japan Road Contractors Associations

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JRCA
JAPAN ROAD CONTRACTORS ASSOCIATION

SHORT BIO : KAZUNARI HIRAKAWA

- Title

: Senior Director of Taisei Rotec Research Institute
: Member of REAAA Pavement Technical Committee
: Secretary of ISAP NAGOYA 2010 Committee (2010-2011)
: Member of ISAP APE 2017 Technical Committee(2017)
: Sub- member of Pavement Committee in Japan Road Association
: GAPA –JAPAN WG Leader, Director of Inter national WG of JRCA (2017-)

- Personal Career

: Post graduated course of Tokyo A & T University
: 2003-2009 Research Institute of Taisei Rotec
: 2009-2013 Department of Consulting & Investigation
: 2013-2015 Researcher Specialist of Pavement
Public Works Research Institute of Ministry of Land, Infrastructure, Transport and Tourism(MLIT).
:2015 -2023 Research Institute of Taisei Rotec (Senior Director)
:2024- Head of Advanced Institute of Research and Development

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Topics

1. History of Pavement Recycling
2. Overview of Pavement Recycling
3. Key Technology
   - : Reclaimed Asphalt Pavement
   - :Rejuvenator for Recycling
   - :Concept of mix design
   - :Recycling Asphalt plant
4. Latest Topic
   - :Repetitive Recycled Asphalt
   - :Recycling WMA for Carbon Neutral
   - :The Next Gen Pavement Test Track

1.History of Pavement Recycling

- **Legislation and Guidelines since 70s**

→Promoting Pavement Recycling

1970s Development of Recycling Technology for Pavement Wastes was started.

1984 Published "Handbook of Recycling Technology of Pavement Waste"

1986 Published "Handbook of In-situ Surface Recycling"

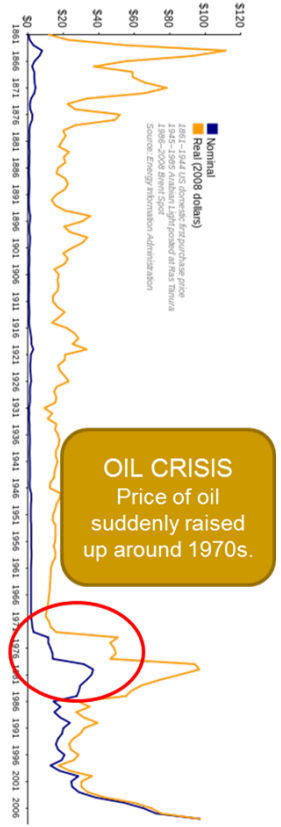
1987 Published "Handbook of In-situ Basecourse Recycling"

1992 Published "Handbook of Plant Recycling of Pavement"

1991 Act on the Promotion of Effective Utilization of Resources

2004 Published "Guideline for Recycling waste of pavement"

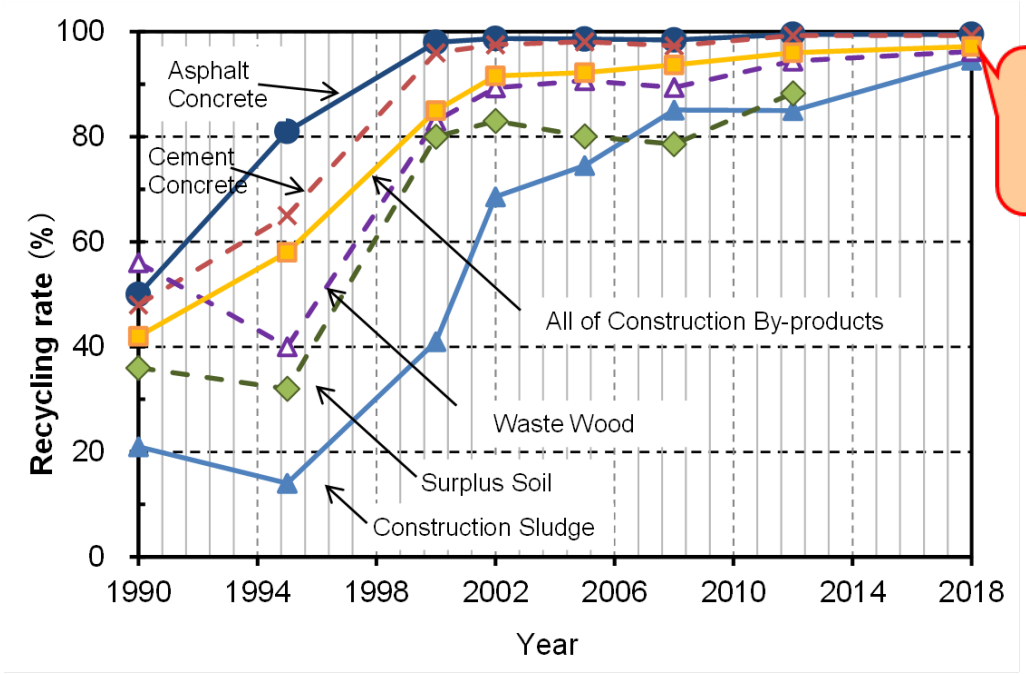
2010 Revised "Guidline for Recycling wate of Pavment"



1. History of Pavement Recycling

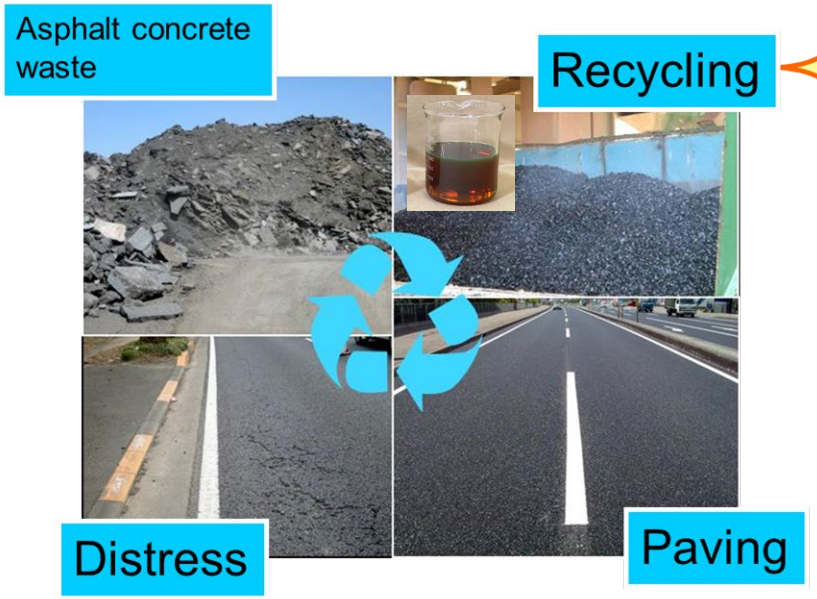
Recycling rate of Construction waste

- **Recycling Ratio of Asphalt Concrete became more than 98% since 1990s**



2. Overview of Pavement Recycling

Recycling Method for Pavement

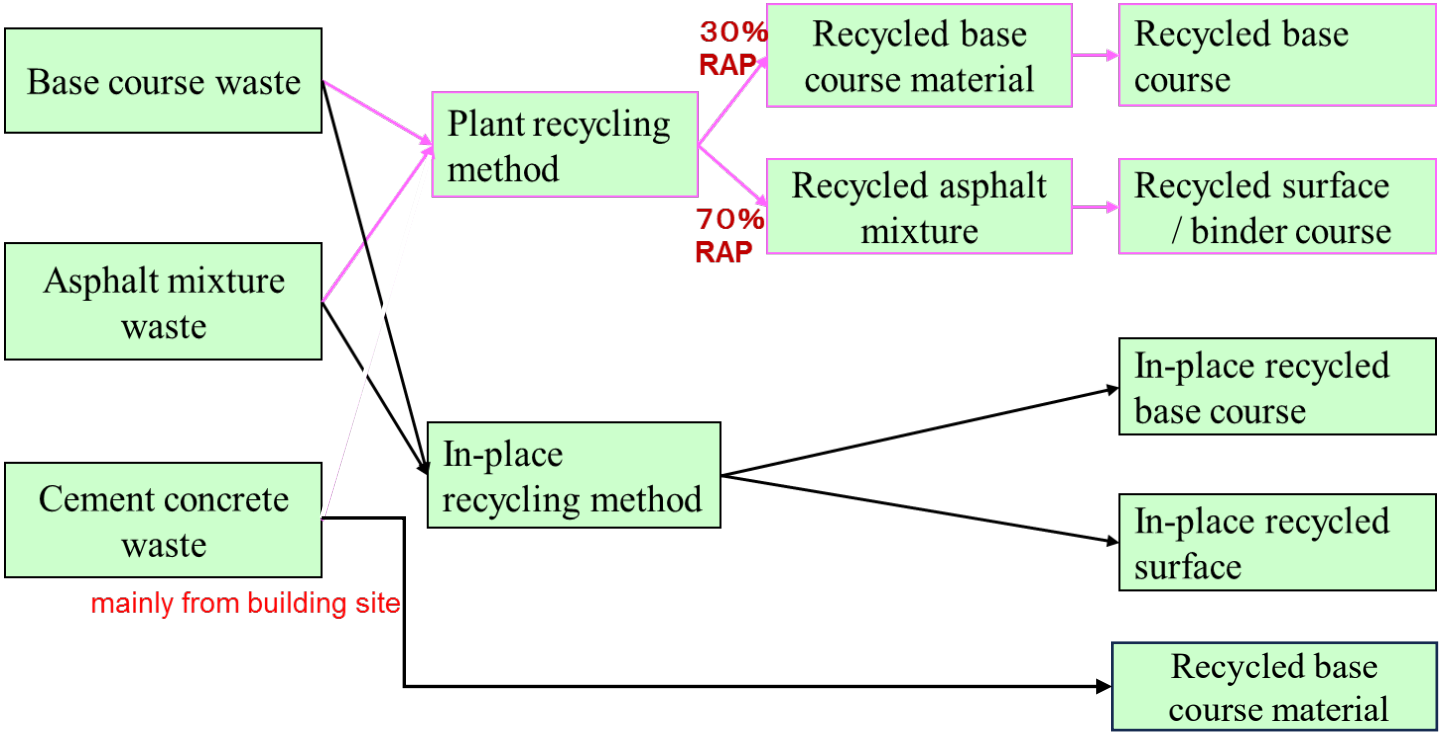


Plant recycling

In-situ recycling

2. Overview of Pavement Recycling

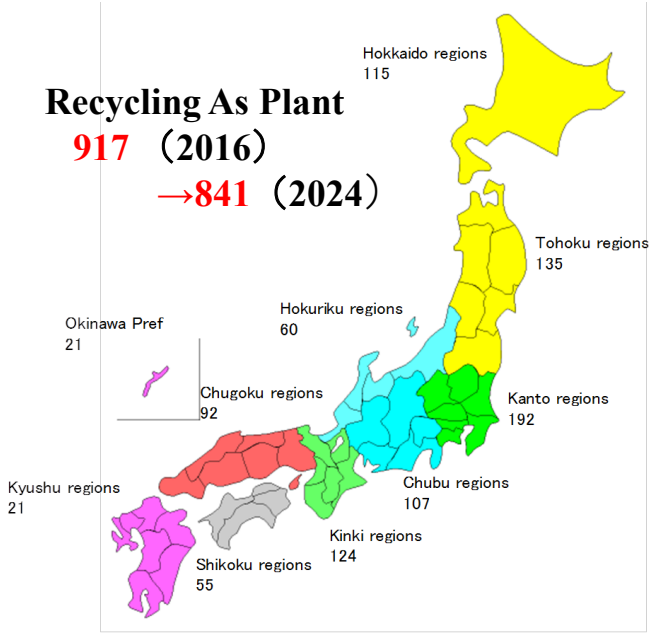
Recycling for Pavement

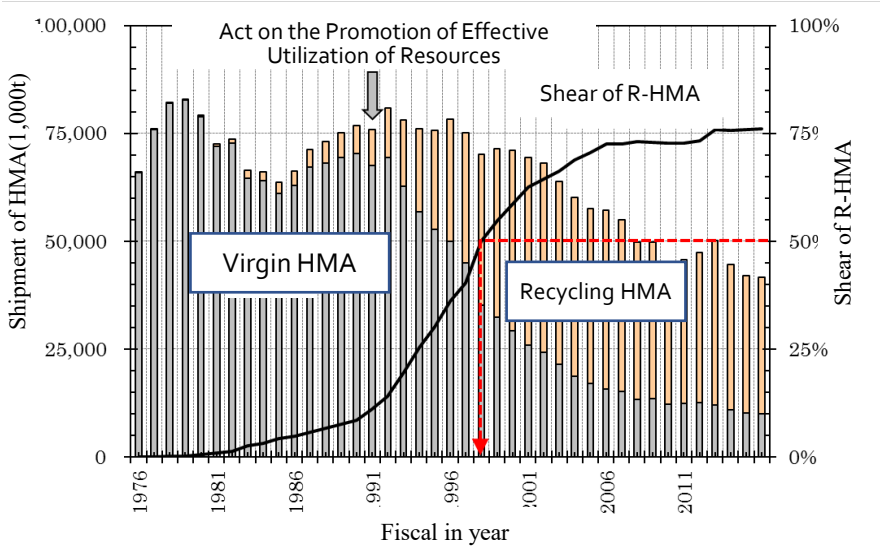


2. Overview of Pavement Recycling

Asphalt Plant and Shipment

- Recycling As Plants located widly.
- R-HMA occupies 75% of Total Shipment





3. Key Technology

Reclaimed Asphalt Pavement

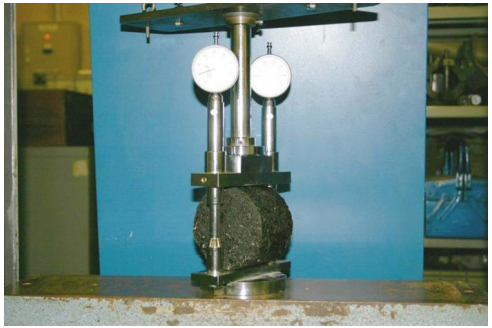
- **Specification for RAP**

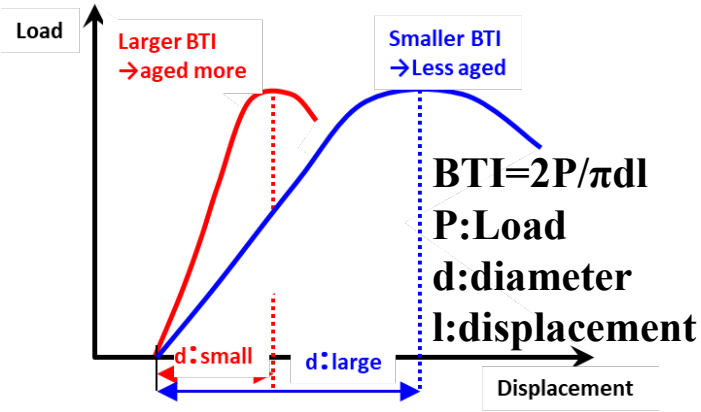
Asphalt Content %	>3.8
Extracted Asphalt from RAP Penetration 1/10mm Bituminous Tenacity Index Mpa/mm	 >20 >1.70
Content of materials finer than 75μm %	<5

Dumping

Crushing sieving

- **Test Method(BTI)**





3. Key Technology

Rejuvenator Specification

Dynamic Viscosity (60℃) mm^2/s	80～1,000
Flash Point ℃	>250
Viscosity ratio after TFO (60℃)	<2
Weight Change after TFO %	With in ±3
Density (15℃) g/cm^3	To be reported
Chemical Component	To be reported

Aged Asphalt

Rejuvenator

Recycling Asphalt

3. Key Technology

Mix design

2 Methods are permitted.

1.To adjust pen for aged asphalt(RAP) to design penetration

→Rejuvenate aged asphalt of RAP by rejuvenator

Recyling As cont = aged As + rejuvenator + newly As

Mix Design→Air Void、 Saturation to meet spec

※Design pen is usually 50

2.To adjust BTI for Recycling HMA to design BTI

Based on tentative Recycling As cont,

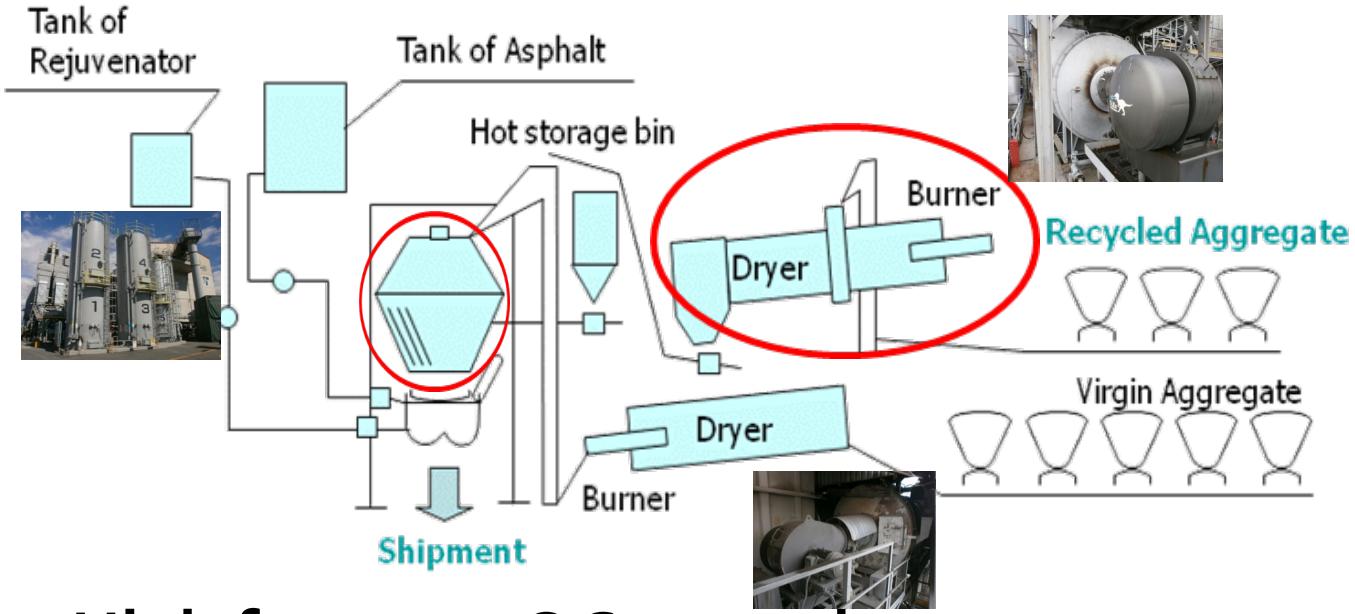
→Decide Rejuvenator ratio to meet design BTI

Mix Design→Air Void、 Saturation to meet spec

※Design BTI is usuall between 0.60-0.90Mpa/mm

3. Key Technology : Recycling Asphalt Plant

- **Batch type Plant with Twin dryer system**



- **High frequncy QC on each stage**

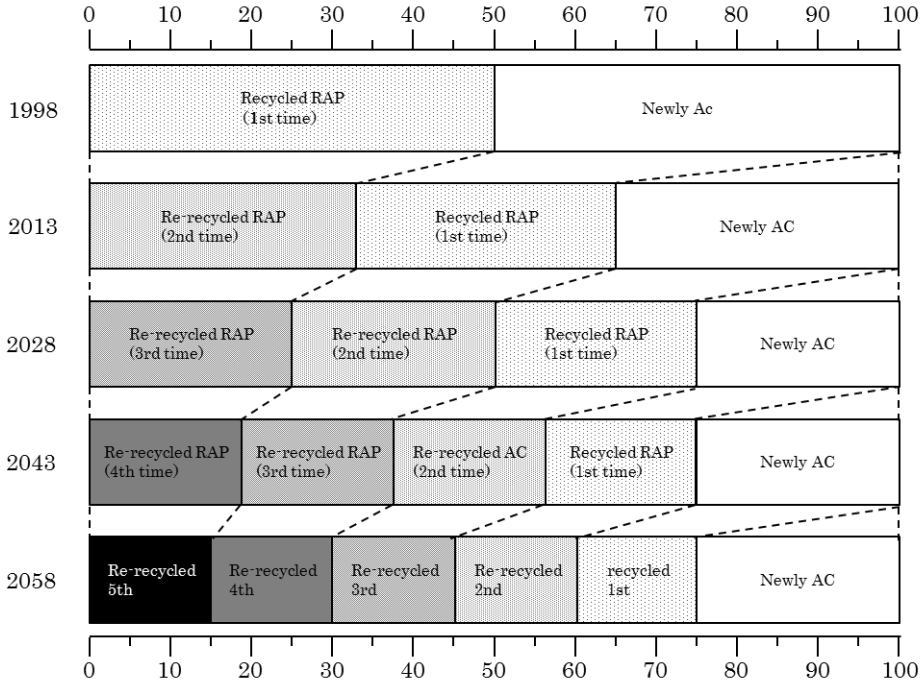
  Rap and materials、self-printing、performance of R-HMA

4. Latest Topic : Repetitive Recycled Asphalt

Assumed RAP blendiong ratio at 50-75% and pavment life is 15ys ･･･40years after

RAP blending ratio is More than 70% with re-recycled RAP

Essensial to study on Repetitive recycling



KAWAKAMI, A., et al. (2023). Properties of Repeatedly Recycled Bitumen Using Rejuvenators With Aromatics and Saturates Components, IP0784, XXVIIth World Road Congress.

4. Latest Topic : Repetitive Recycled Asphalt

Motivation

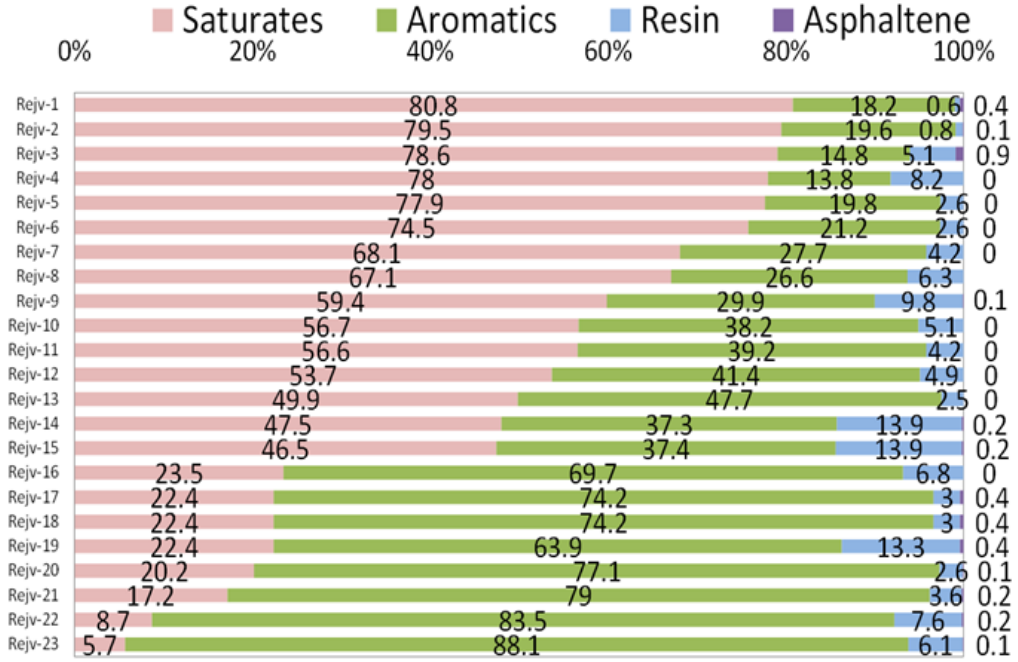
Seeking suitable rejuvenator for repeatedly recycling.

Focus

Different types (composition)of rejuvenator are widely used in Japan.

Output

To clarify the changes in properties of repeated recycled bitumen and asphalt mixture.



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4.Latest Topic : Repetitive Recycled Asphalt

Sample

3 types of rejuvenator

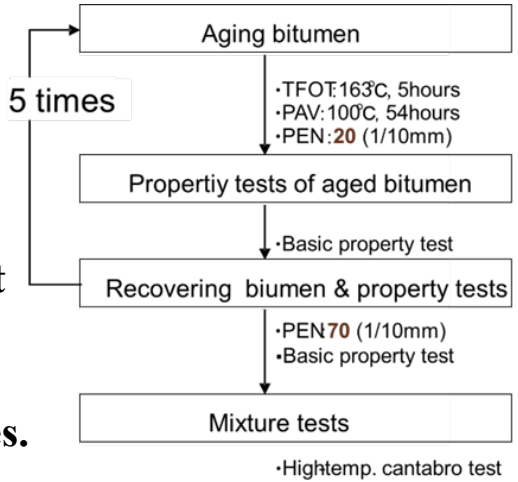
Bitumen (ORG)	Density [g/cm³]	Penetration [1/10mm]	Softening point [°C]		Ductility [cm]
	1.037	70	46.5		Over 100
Rejuvenator	Density [g/cm³]	SARA fractionation [%]			
		Saturates	Aromatics	Resins	Asphaltenes
A (RejA)	0.975	5.7	88.1	6.1	0.1
B (RejB)	0.909	49.9	47.7	2.5	0.0
C (RejC)	0.863	99.9	0.1	0.0	0.0

Aging-Recycling Process

Bitumen was aged in a laboratory using TFOT and PAV.

Added the rejuvenators with different SARA component for recycling.

These process were repeated five times. Material and mixture tests were conducted in each stage



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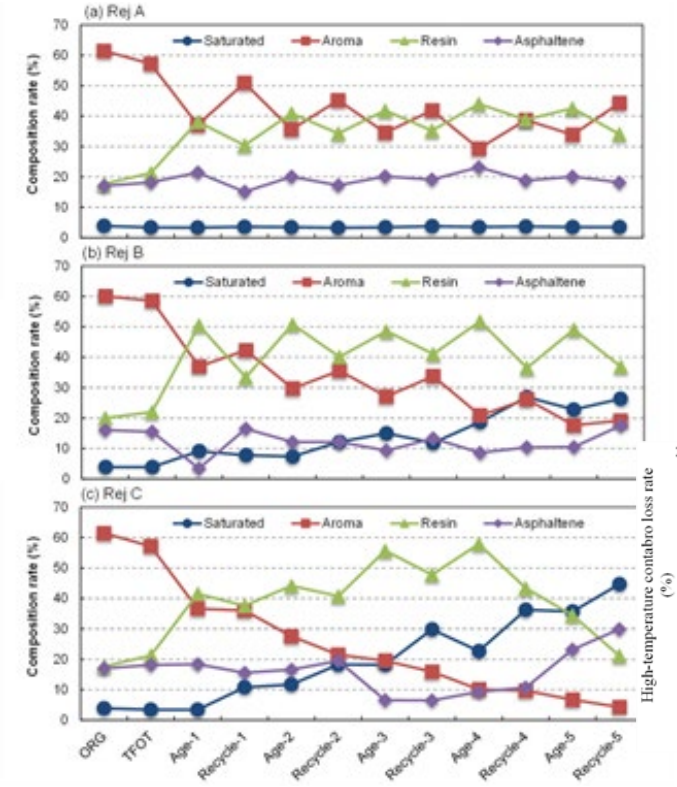
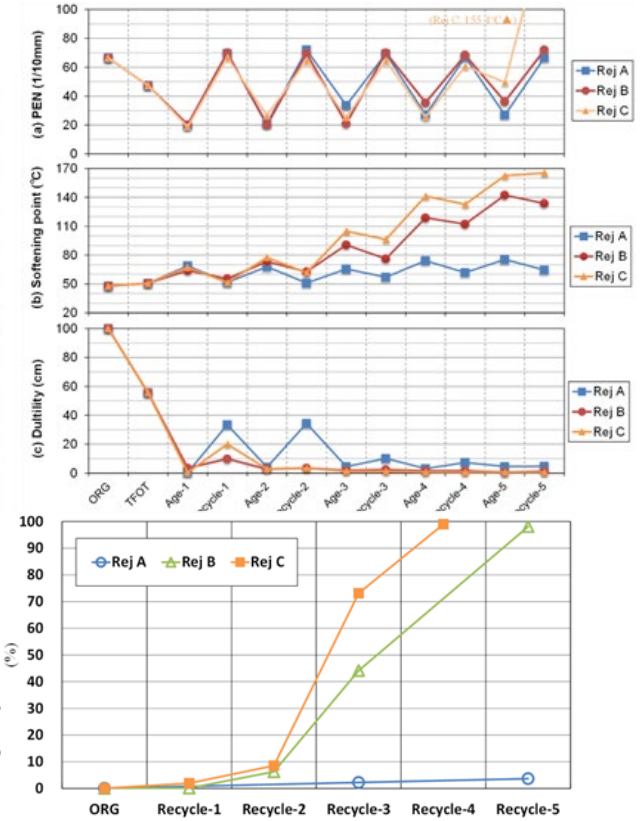
Result





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4.Latest Topic : Repetitive Recycled Asphalt

Conclusion

Result

Tendency after the repeatedly recycling of bitumen

- **A higher softening point**
- **Lower ductility**
- **Less crack resistance at high temperature**
- **Depends on the AR and SA of rejuvenator.**

Conclusion

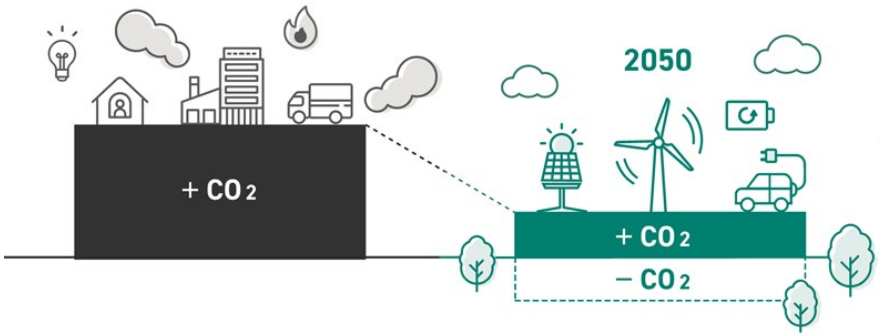
This tendency was greater depending on the type of rejuvenator.
Especially in the case of rejuvenator having
a high saturates components rather than a high aromatic components

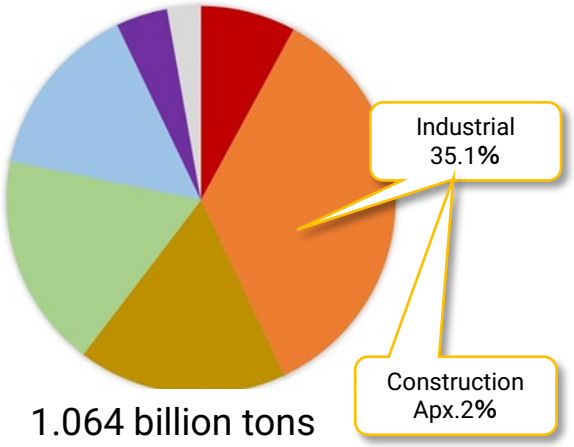
KAWAKAMI, A., et al. (2023). Properties of Repeatedly Recycled Bitumen Using Rejuvenators With Aromatics and Saturates Components, IP0784, XXVIIth World Road Congress.

4.Latest Topic :

Recycling WMA for Carbon Neutral

JAPAN aim at “Reducing overall greenhouse gas emissions to zero by 2050”
Target : Reduce greenhouse gas emissions by 46% in 2030 compared to 2013





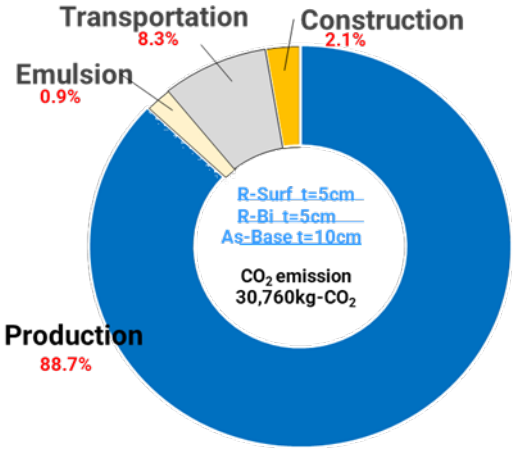
1.064 billion tons
(in 2021)

4. Latest Topic :

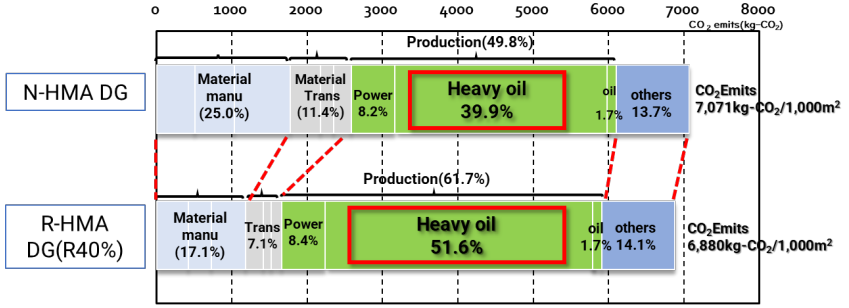
Recycling WMA for Carbon Neutral

Pavement construction: Approximately 3.4 million t-CO2/year
Asphalt pavement construction, mainly emits in HMA Producing process
(approximately 2.8 million-tCo2/year :80% of total)
Countermeasures at the production process are particularly effective.

:Refocus on WMA



CO2 emission in AC pavement construction(1000m²)



CO2 emission in AC production (for 1000m²)

Reference: Carbon Neutral Committee, JRCA 2024

4. Latest Topic :

Recycling WMA for Carbon Neutral

JRCA Road Map R-WMA: low carbon pavement

Until 2030

Initiatives to achieve CO2 reduction target of 46% (compared to 2013)

- Promote the spread of existing technologies (low-carbon pavement, highly durable pavement, long-life pavement)
- Strengthening collaboration with related organizations
- Approaching other organizations such as the government

Until 2040

Initiatives to further reduce CO2 emissions

- Development of new low-carbon pavement technology
- Development and implementation of carbon negative technology

Until 2050

- Promoting the spread of technology towards carbon neutrality
- Pavement construction:

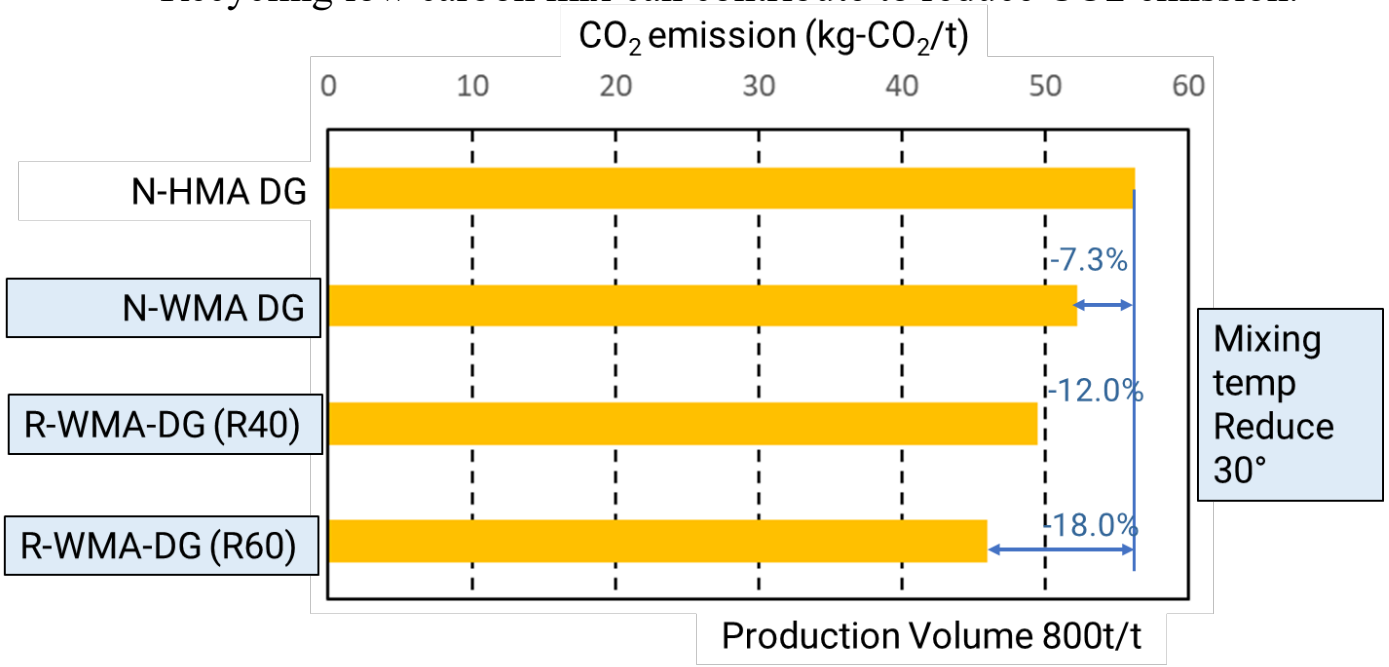
Reference: Carbon Neutral Committee, JRCA 2024

4. Latest Topic :

Recycling WMA for Carbon Neutral

CO2 Emission on HMA

Recycling low carbon mix can contribute to reduce CO2 emission.

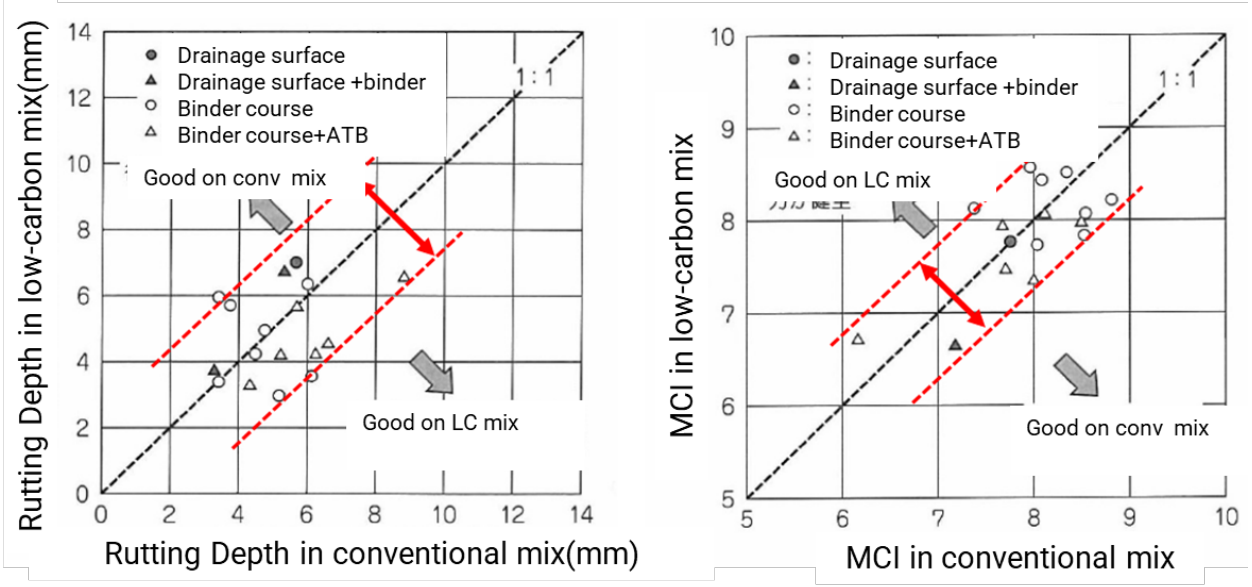


Reference: Carbon Neutral Committee, JRCA 2024

4. Latest Topic :

Recycling WMA for Carbon Neutral

Performance of low-carbon mix in service road



(13 sections, service period from 2 months to 10 years)

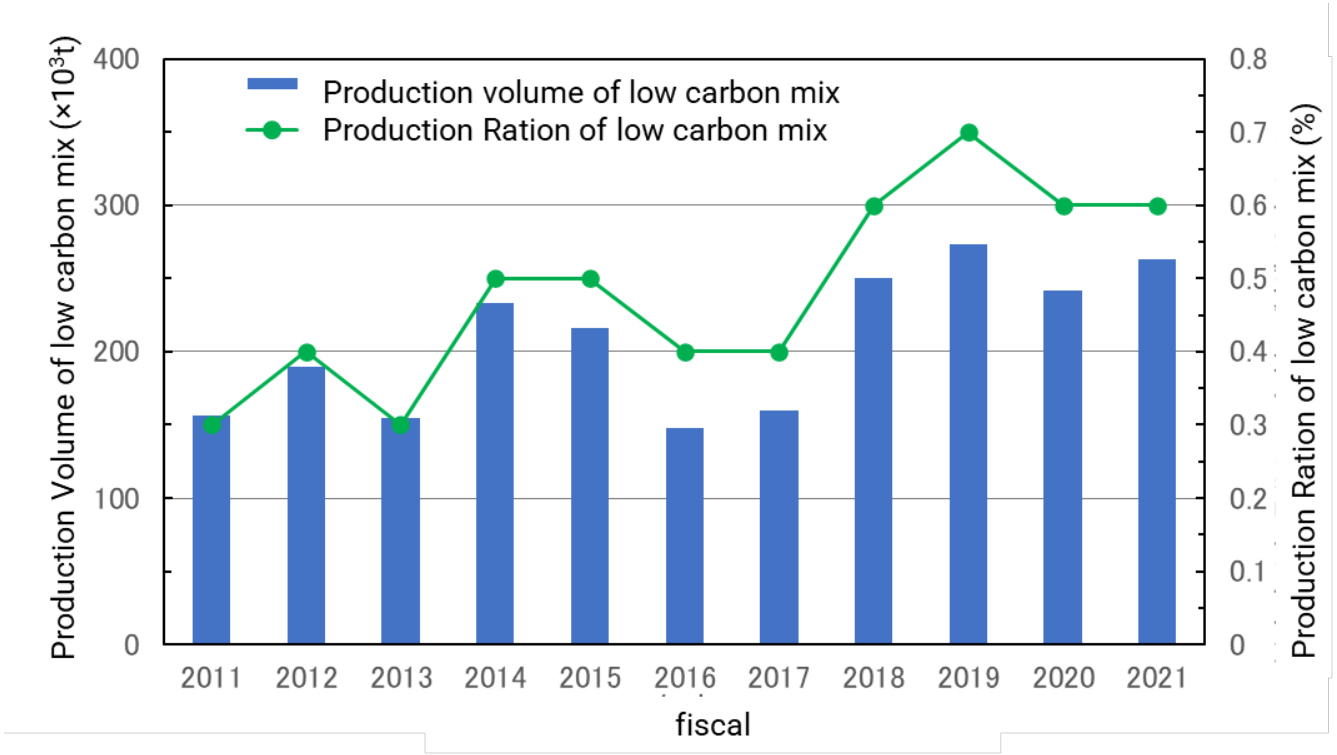
Low-carbon mix are considered to have the same level of pavement performance as conventional mix

Reference: Carbon Neutral Committee, JRCA 2024

4. Latest Topic :

Recycling WMA for Carbon Neutral

Transition of low carbon mix Production Amount



4. Latest Topic : The Next Gen Pavement Test Track

- 909m Test Track Evaluating 18 Pavement Types
- Autonomous Operation of 5 Large Vehicles at 40 km/h
- Control and Presentation Spaces in Management Building

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