Pavement Recycling Technology for Highways in Japan

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Contents

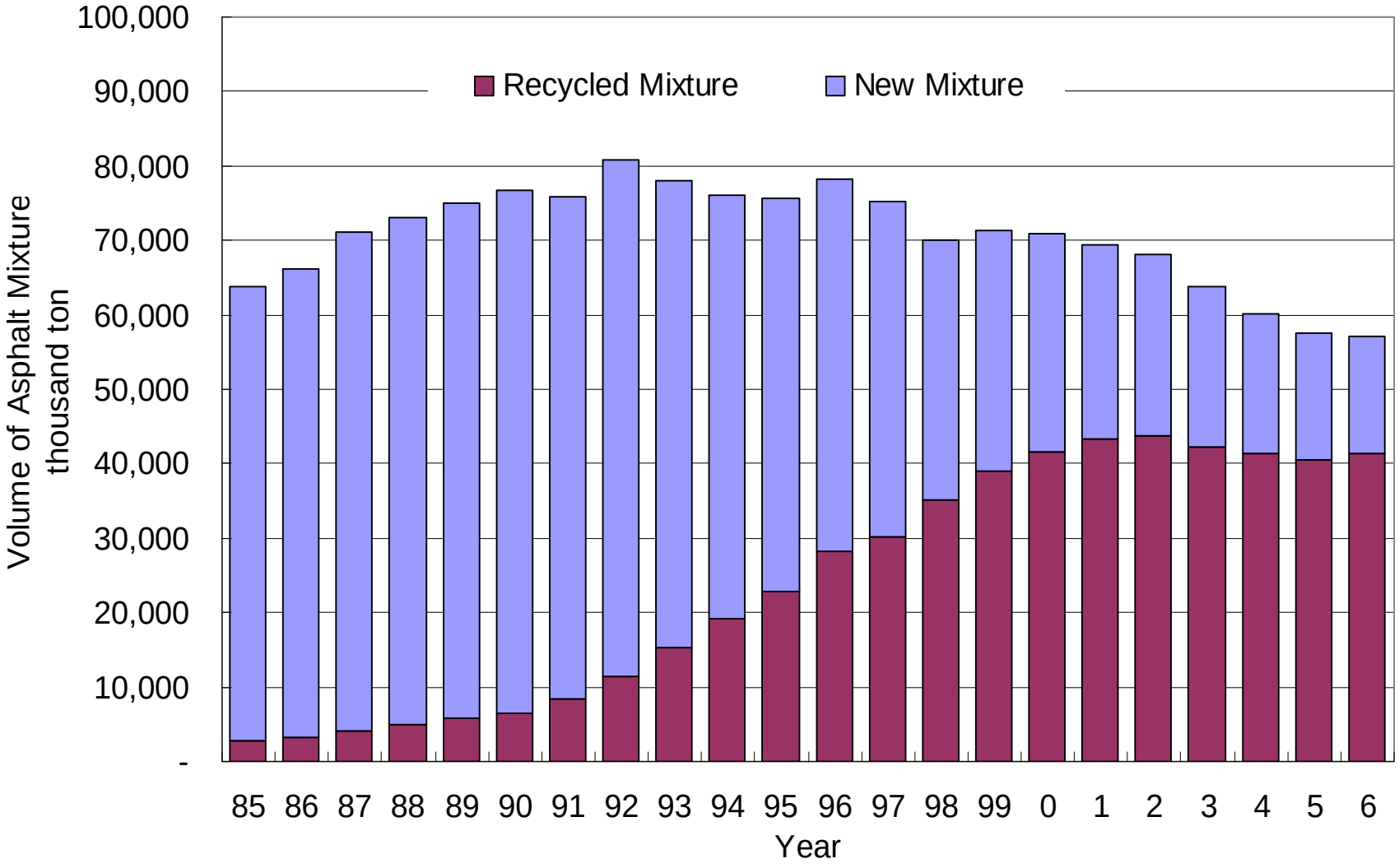
1. History of Pavement Recycling in Japan
2. From Construction to Maintenance
3. Pavement Distress and Rehabilitation Method
4. Hot In-place Rehabilitation
5. Need for Porous Asphalt Pavement Recycling
6. Conclusion

1. History of Pavement Recycling in Japan

1.1 Pavement Recycling Technologies

	70’	80’	90’	00’	10’
Pavement Recycling Technologies	・Hot Mix Asphalt Recycling (Batch Plant) (1977) ・Hot In-place Rcycling(1978)			・Hot In-place Transforming(2005) ・Hot In-place Strengthening (2007) ・Steel Deck Asphalt Recycling(2007)	

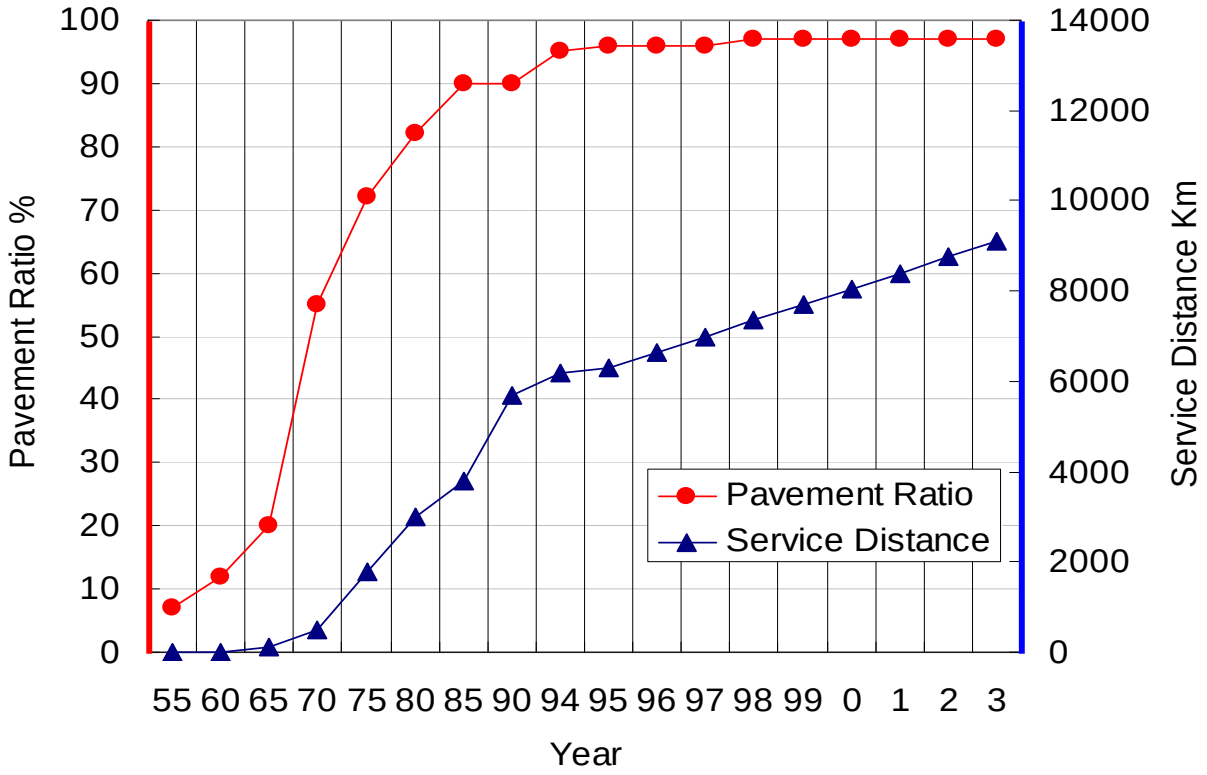
1.2 Volume of Asphalt Mixture



2. From Construction to Maintenance

2.1 Pavement Ratio

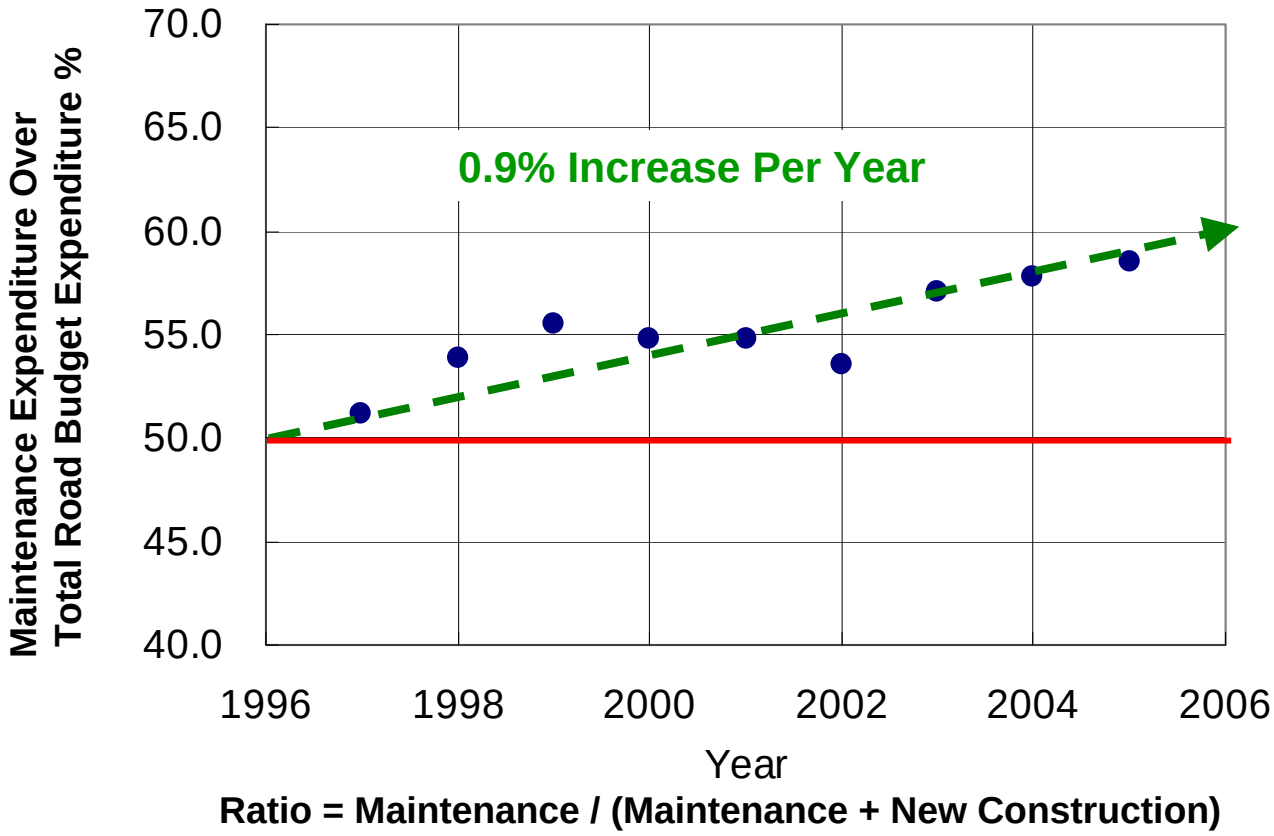
Present State of **National Highway** and **Provincial Highway**



Note: Target Length of Arterial High-standard Highway is 14000km

Source : MLIT Japan

2.2 Maintenance Expenditure Ratio



Ratio = Maintenance / (Maintenance + New Construction)

Source : MLIT Japan

3. Pavement Distress and Rehabilitation Method

Source : US Federal Highway Administration

3.1 Pavement Preservation Guidelines

Pavement Preservation Guidelines

	Type of Activity	Increase Capacity	Increase Strength	Reduce Aging	Restore Serviceability
	New Construction	×	×	×	×
	Reconstruction	×	×	×	×
	Major (Heavy) Rehabilitation		×	×	×
	Structural Overlay		×	×	×
	Minor (Light) Rehabilitation			×	×
Pavement Preservation	Preventive Maintenance			×	×
	Routine Maintenance				×
	Corrective (Reactive) Maintenance				×
	Catastrophic Maintenance				×

Source : FHWA

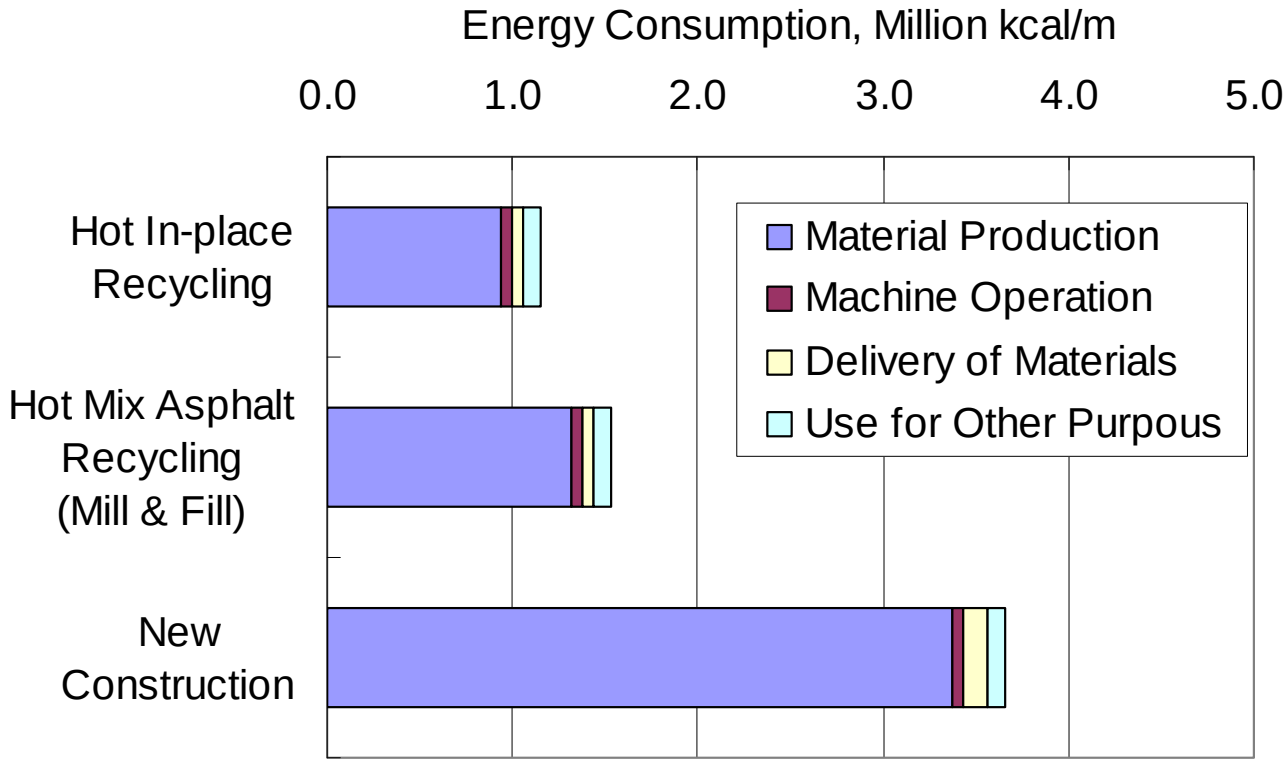
3.2 Rehabilitation Methods of Frequent Use

	Re-habilitation Method		Mill & Fill	HIR	CIR	Micro Surfacing (Slurry Seals)
Type of Pavement Distress	Rutting		○	○	○	△
	Unevenness(Corrugation)		○	○	–	×
	Cracking	Alligator	○	△	○	×
		Longitudinal	○	○	○	×
		Transverse	○	△	○	×
	Raveling		○	○	–	○
	Bleeding		○	○	–	△
	Slipperiness		○	○	–	○
Characteristics	Existing Asphalt Mixture		Hard Milling or Excavation	Loosening	Hard Milling	—
	Aggregate in Use		Crushed and Disposed	Not Crushed	Crushed	—
			Replace	100% Onsite Reuse	100% Onsite Reuse	—
	Mixture Gradation		–	Unchanged	Changed	—
	Pre-Treatment Under Layer		Tack Coat	Not Required	Cleaning and Tack Coat	Cleaning and Tack Coat
	Transport Reclaimed Materials to Plant		By Truck	Not Required	Not Required	Not Required

– Usually not used △ Probable

○ Suitable × Unsuitable

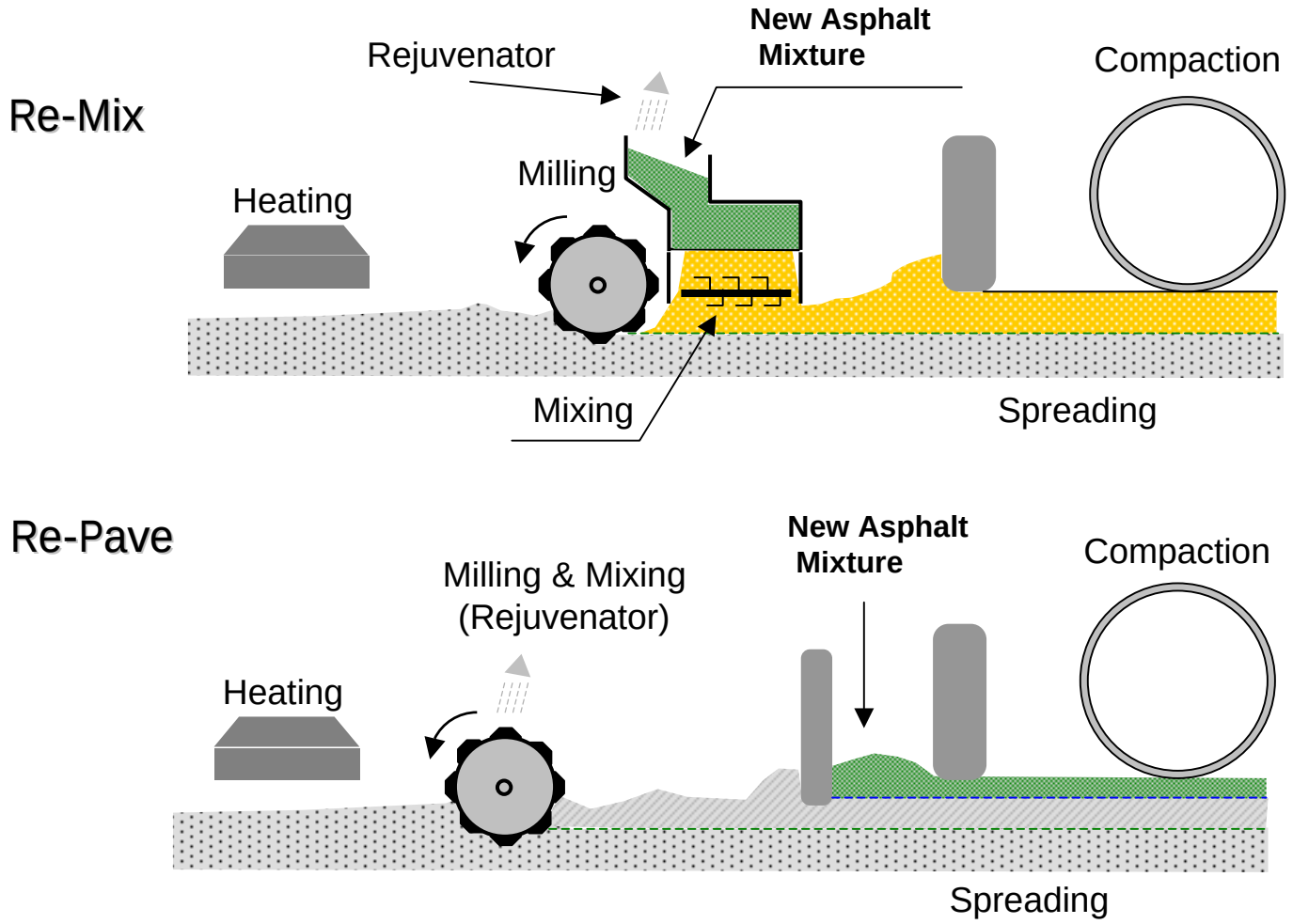
3.3 Comparison of Rehabilitation Methods in Terms of Energy Consumption



Source : Katawaki.S, The Expansion of New Civil Engineering Materials

4. Hot In-place Rehabilitation

4.1 Address Surface Distress (Hot In-place Recycling)



Re-Pave

Hokuriku Expressway(1980s)

Re-Mix

National Highway Route 41(1980s)

Source : Association for Advancement of Surface Recycle Technology

4.2 Applicable Area (Hot In-place Recycling)

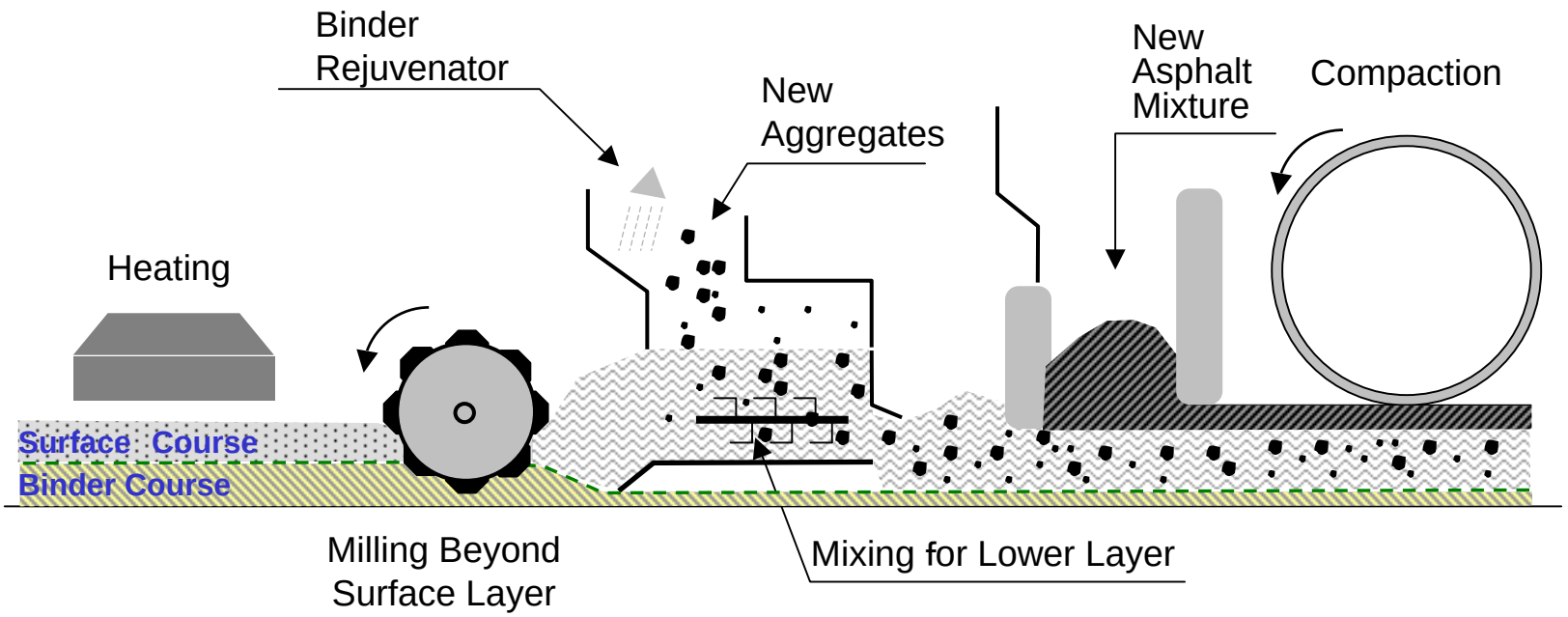
Pavement Preservation Guidelines

	Type of Activity	Increase Capacity	Increase Strength	Reduce Aging	Restore Serviceability
	New Construction	×	×	×	×
	Reconstruction	×	×	×	×
	Major (Heavy) Rehabilitation		×	×	×
	Structural Overlay		×	×	×
Pavement Preservation	Minor (Light) Rehabilitation			×	×
	Preventive Maintenance			×	×
	Routine Maintenance				×
	Corrective (Reactive) Maintenance				×
	Catastrophic Maintenance				×

Source : FHWA

4.3 Address Structural Distress (Hot In-place Strengthening)

New Technology



4.4 Applicable Area (Hot In-place Strengthening)

New Technology

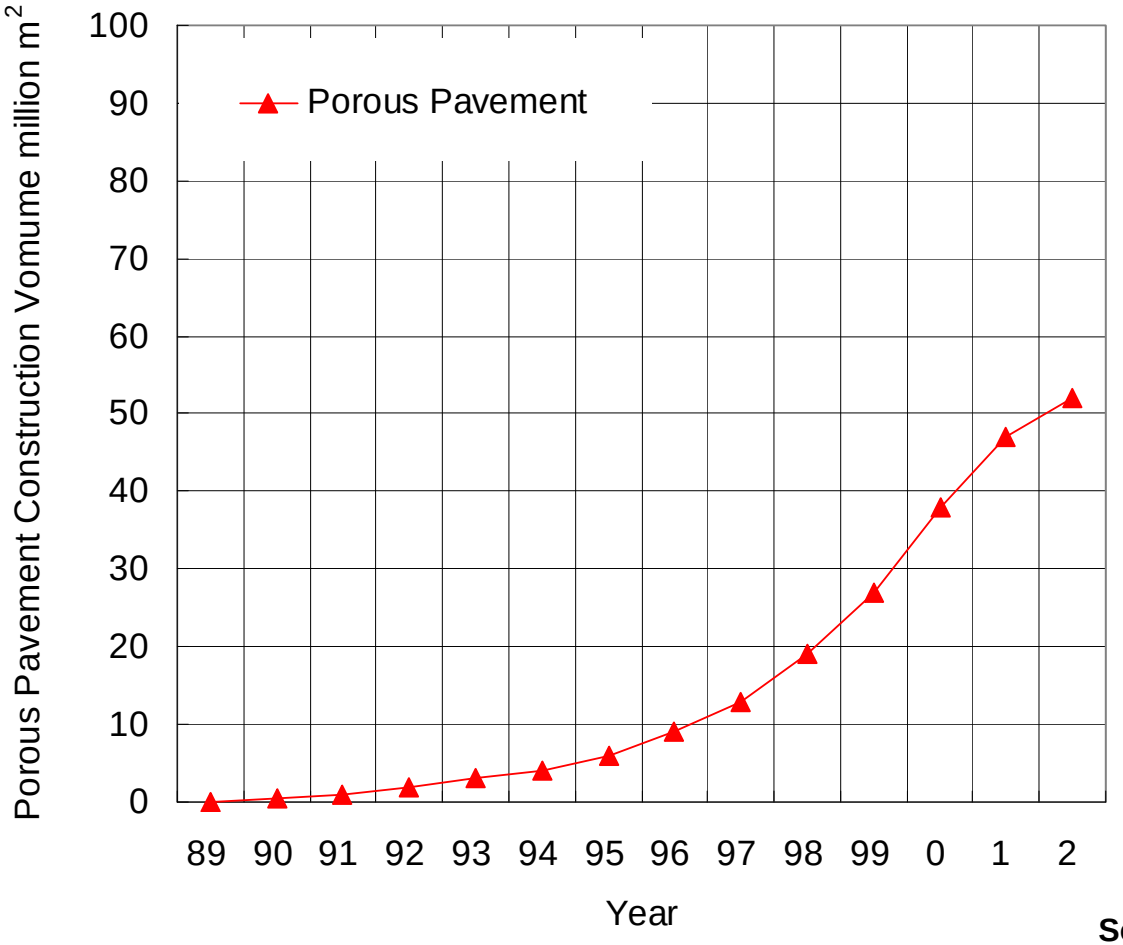
Pavement Preservation Guidelines

	Type of Activity	Increase Capacity	Increase Strength	Reduce Aging	Restore Serviceability
	New Construction	×	×	×	×
	Reconstruction	×	×	×	×
	Major (Heavy) Rehabilitation		×	×	×
	Structural Overlay		×	×	×
Pavement Preservation	Minor (Light) Rehabilitation			×	×
	Preventive Maintenance			×	×
	Routine Maintenance				×
	Corrective (Reactive) Maintenance				×
	Catastrophic Maintenance				×

Source : FHWA

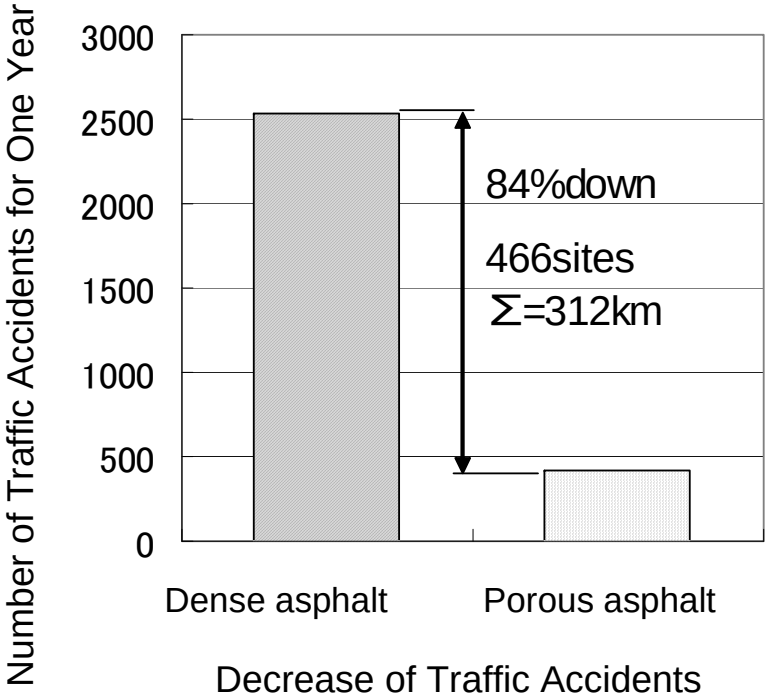
5. Need for Porous Asphalt Pavement Recycling

5.1 Construction Volume

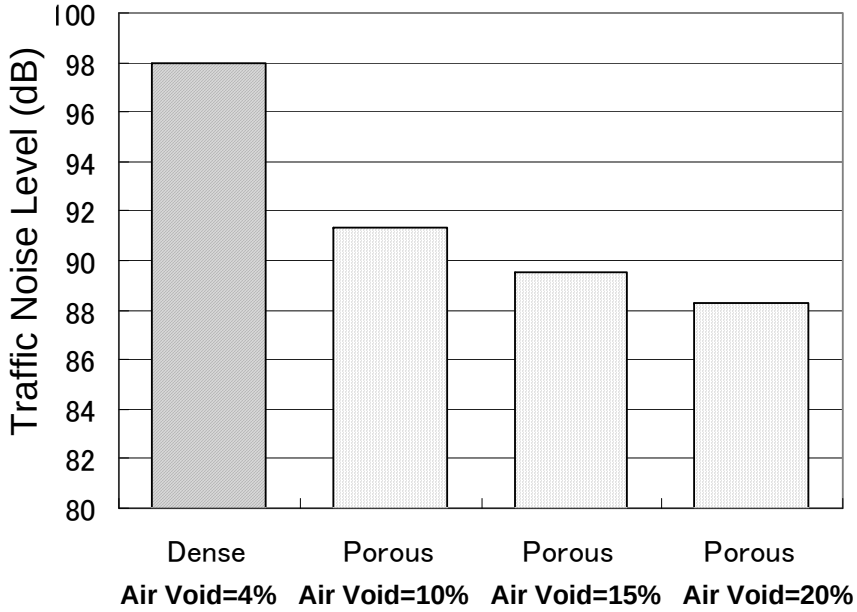


Source : MLIT Japan

5.2 Advantage of Porous Asphalt Pavement



Decrease of Traffic Accidents

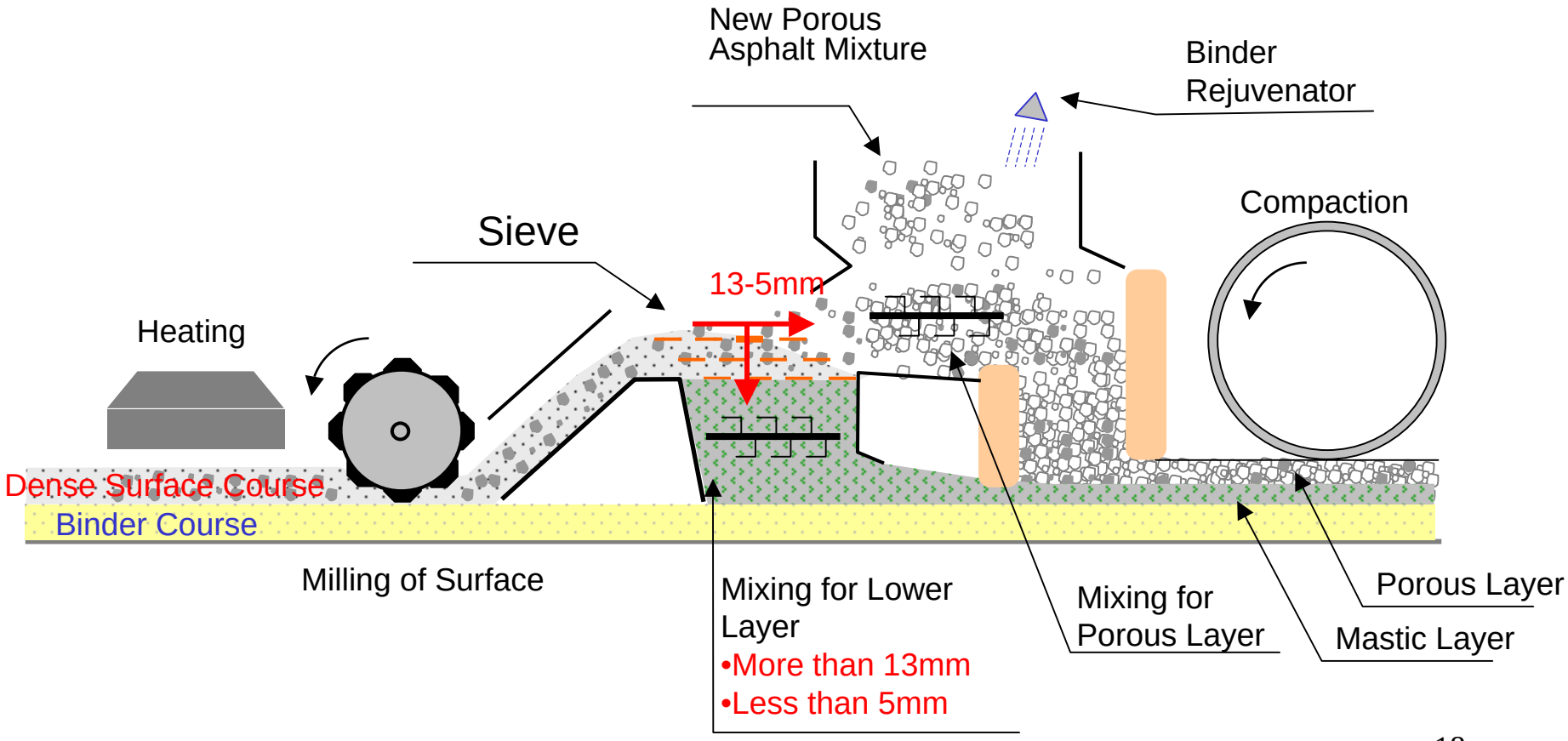


Noise Absorption of Porous Asphalt Concrete

Source : MLIT Japan

5.3 Hot In-place Transforming (Dense to Porous)

New Technology



Hot In-place Transforming Project (Dense to Porous)

Date **September, 2006**

Site **National Highway Route 126 in Chiba Prefecture**

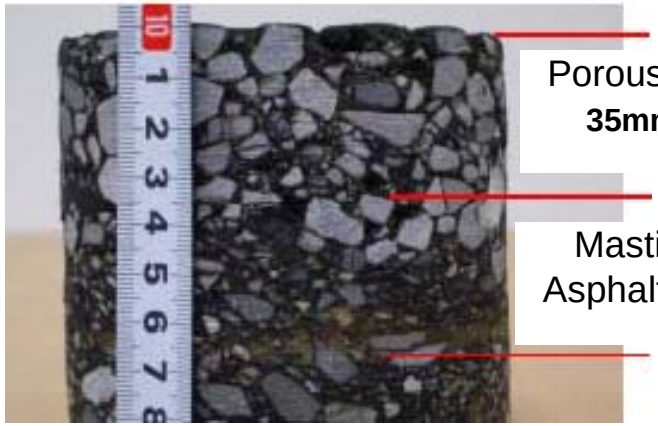
Construction Volume **3,000㎡ （Length：400m×2Lane）**

Construction S

Date **September, 2005**

Site **National Highway Route 77 in Okinawa**

- Core and Marshall Test Results (**National Highway Route 77 in Okinawa)**

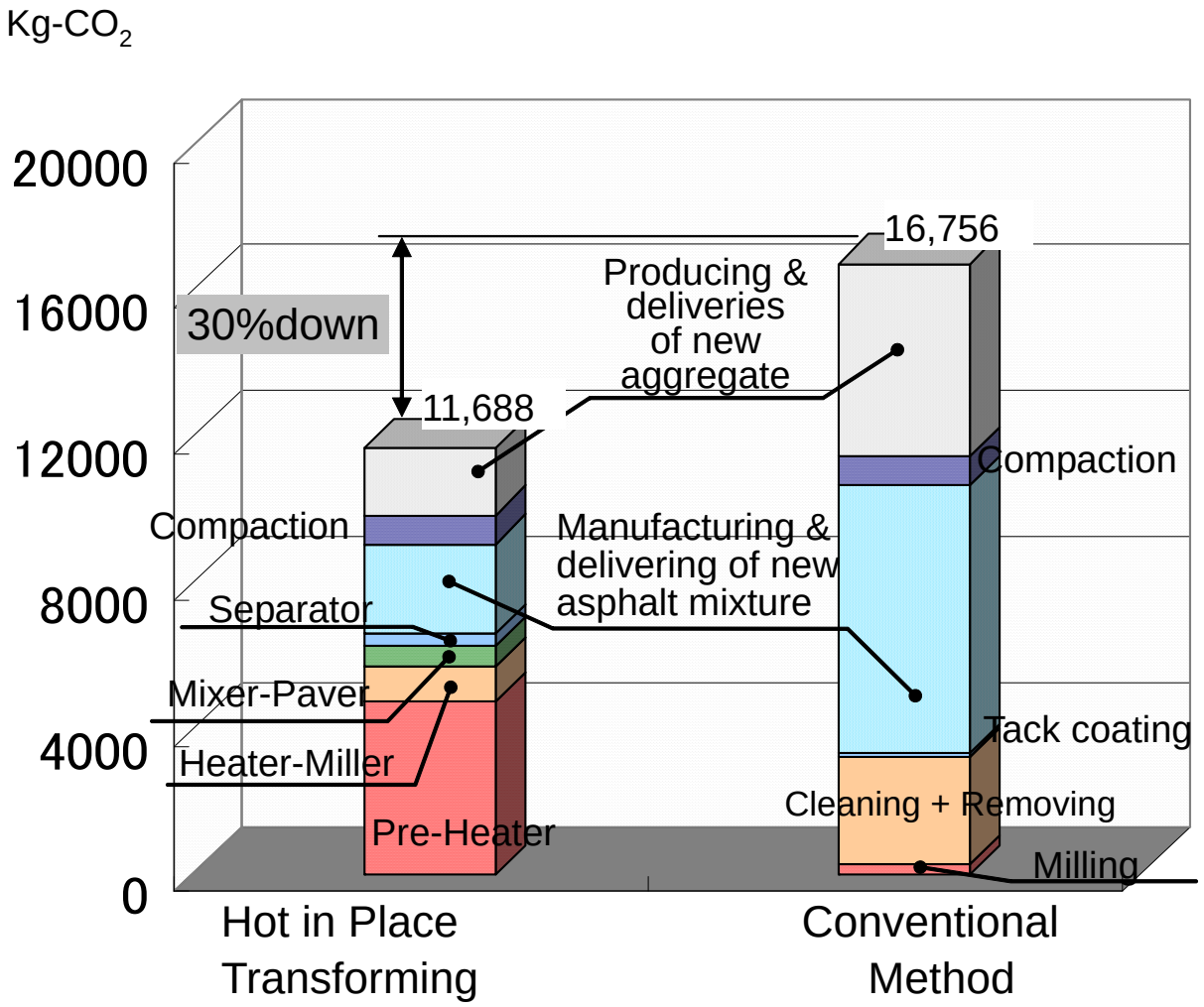


Core Sample taken after Construction

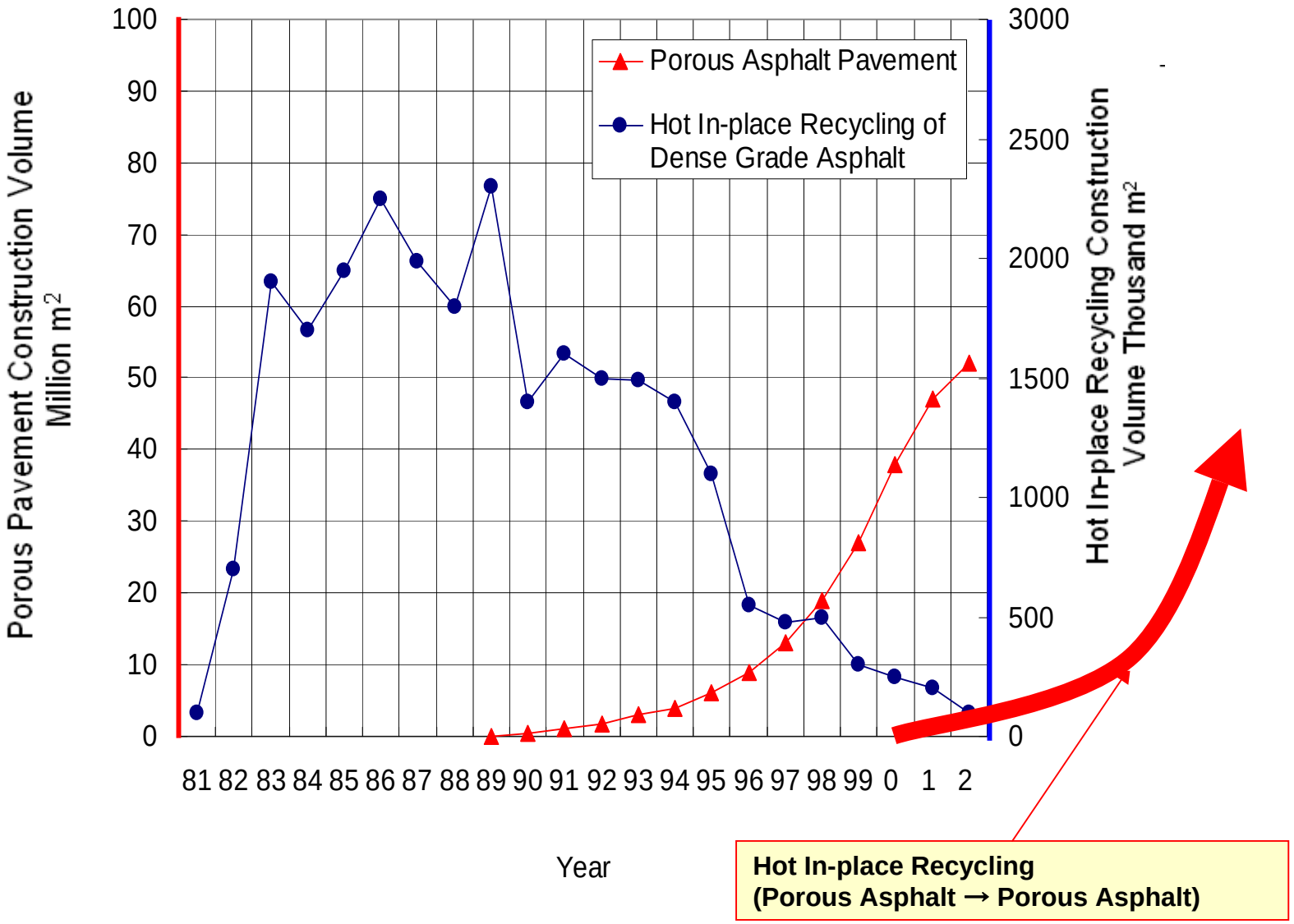
Marshall Test Results of Porous Asphalt Concrete

		Specifications	Measured Value
Marshall Stability	(kN)	> 3.5	4.0
Flow Value	(mm)	2.0–4.0	2.6
Air Void	(%)	> 15	20.0
Coefficient of Permeability	(cm/s)	> 0.01	0.198
Dynamic Stability by Wheel Tracking Test	(Pass/mm)	> 3000	4400

- Reduction of CO_2 Emission

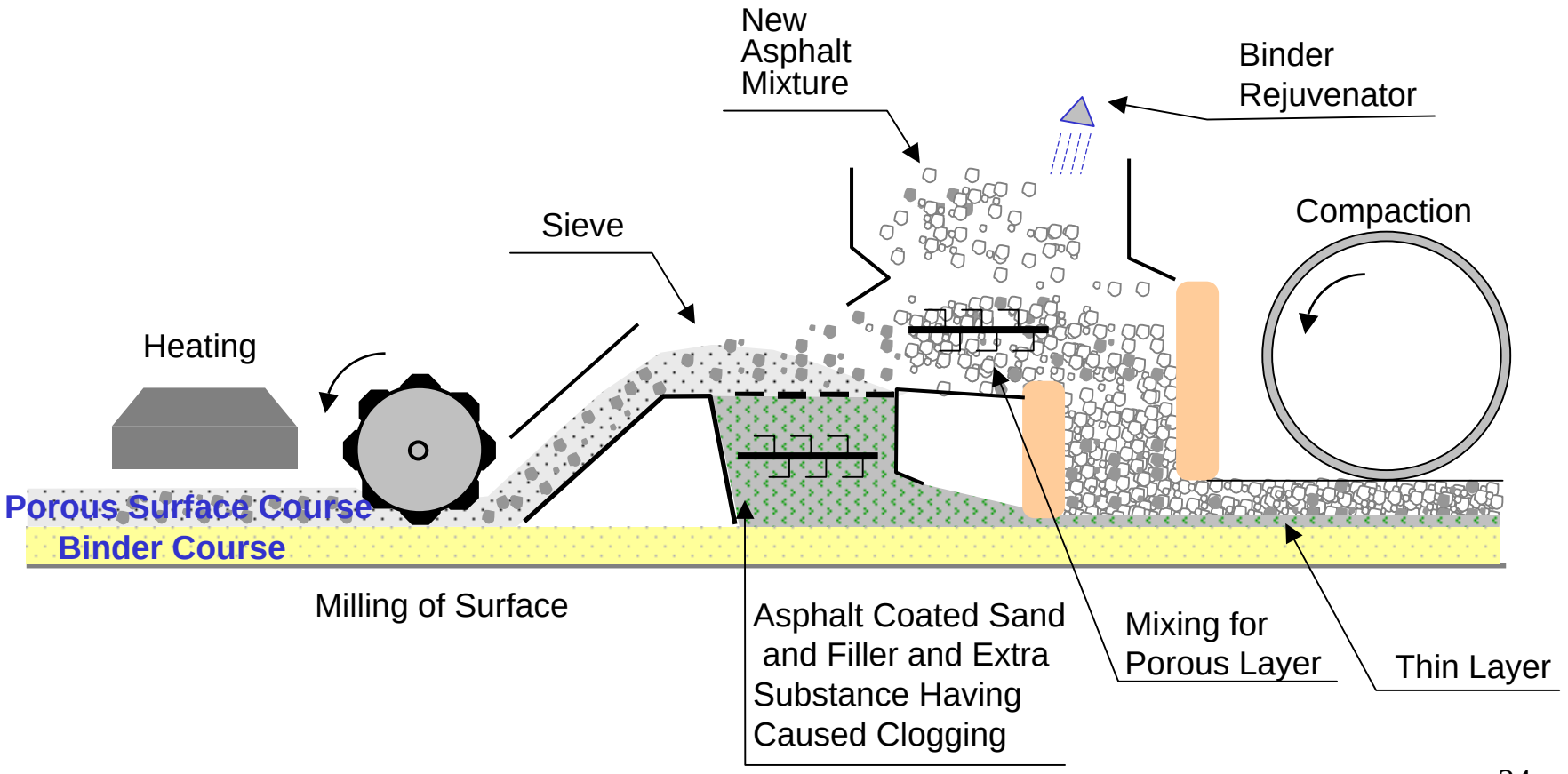


5.4 Need for Hot In-place Recycling of Porous Asphalt



5.5 Hot In-place recycling of Clogged Porous Asphalt

New Technology



6. Conclusion

New Technologies Now Available to Cope with Increasing Needs for

Safety,
Energy Saving,
Resource Saving,
Green House Gas Reduction,
Asset Management