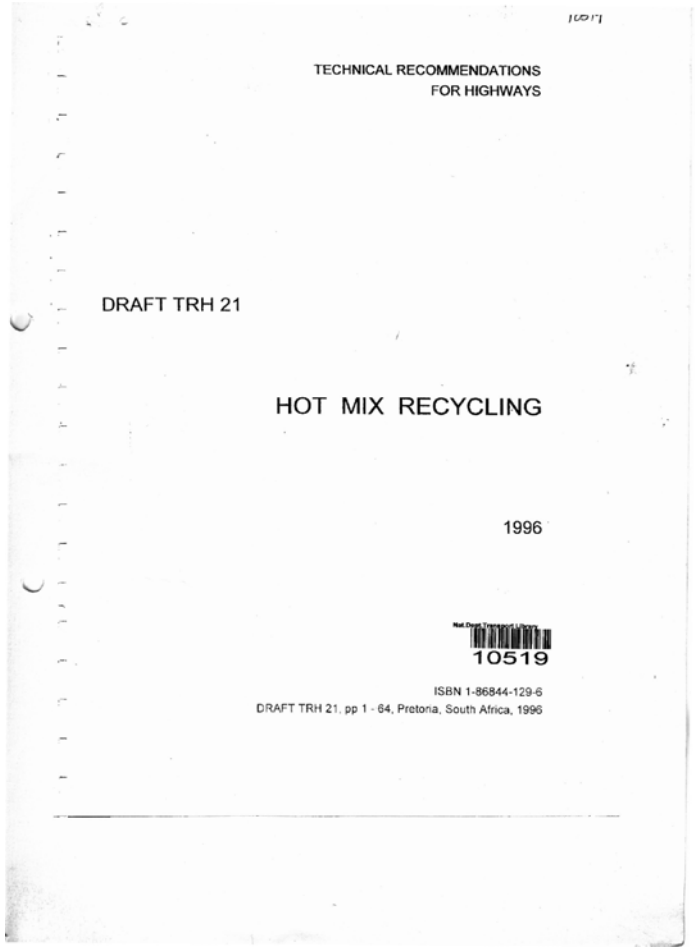
TRH 21: 2009
Hot Mix Asphalt Recycling

Workshopped in Gauteng, W Cape and KZN during June 2009

Draft TRH21 produced in 1996



TECHNICAL RECOMMENDATIONS
FOR HIGHWAYS

DRAFT TRH 21

HOT MIX RECYCLING

1996

ISBN 1-86844-129-6
DRAFT TRH 21, pp 1 - 64, Pretoria, South Africa, 1996

RA typically contains 95% high quality aggregate and 5% bitumen – valuable non-renewable resources

The binder has most probably aged and become brittle but the aggregate quality will not have altered

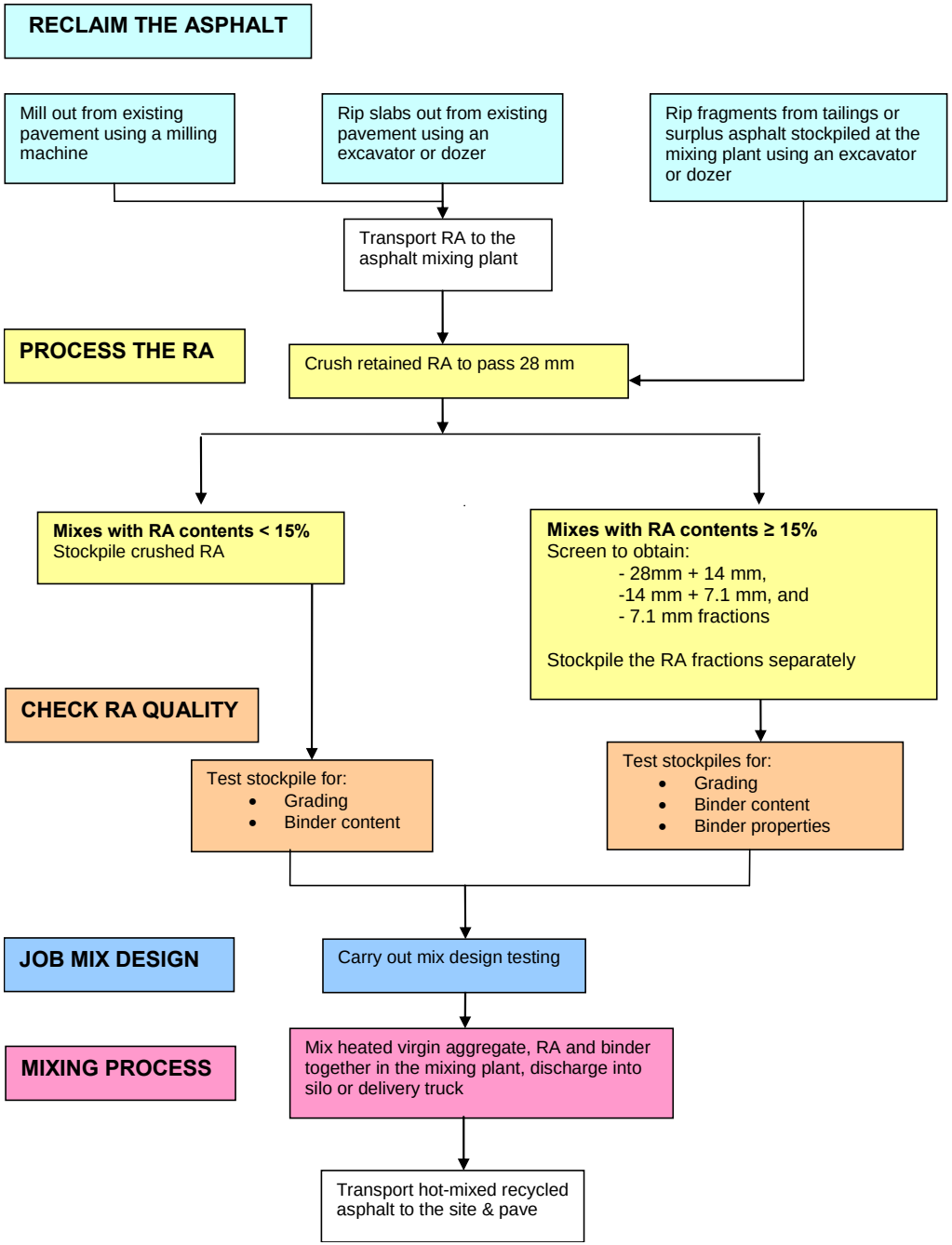
A valuable asset

Alternative aggregate source – linear quarry

“Recycled hot-mixed asphalt containing RA has the same quality and performance requirements as mixes using all new materials”

Layout of TRH21: 2009

- Principles of hot-mix asphalt recycling
- Challenges and solutions to hot-mix recycling
- Factors that influence availability and quality of RA
- Investigation of RA sources
- Reclaiming, preparing and stockpiling RA
- Mix design procedures
- Mixing plant requirements
- Quality control of hot-mix recycled asphalt
- Economic considerations
- Occupational health, safety and the environment
- Case studies


RECLAIM THE ASPHALT
Mill out from existing pavement using a milling machine
Rip slabs out from existing pavement using an excavator or dozer
Rip fragments from tailings or surplus asphalt stockpiled at the mixing plant using an excavator or dozer
Transport RA to the asphalt mixing plant
PROCESS THE RA
Crush retained RA to pass 28 mm
Mixes with RA contents < 15%
Stockpile crushed RA
Mixes with RA contents ≥ 15%
Screen to obtain:
- 28mm + 14 mm,
-14 mm + 7.1 mm, and
- 7.1 mm fractions
Stockpile the RA fractions separately
CHECK RA QUALITY
Test stockpile for:
Grading
Binder content
Test stockpiles for:
Grading
Binder content
Binder properties
JOB MIX DESIGN
Carry out mix design testing
MIXING PROCESS
Mix heated virgin aggregate, RA and binder together in the mixing plant, discharge into silo or delivery truck
Transport hot-mixed recycled asphalt to the site & pave

Reclaiming, preparing & stockpiling RA

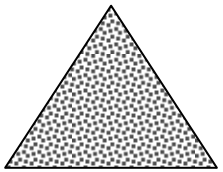
Typical RA fractions and uses in recycled asphalt mixes

Grading of fractionated RA	Typical usage in recycled asphalt mixes
- 28mm + 14 mm	Asphalt base mixes
-14 mm + 7.1 mm	Asphalt base, coarse & medium continuously graded mixes
- 7.1 mm	All above, plus fine continuously graded mixes

Reclaiming, preparing & stockpiling RA

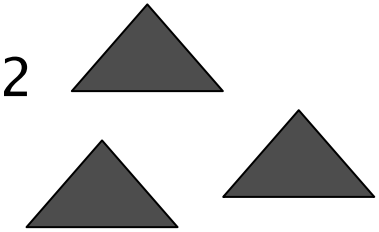
Phased stockpiling of RA

Phase 1



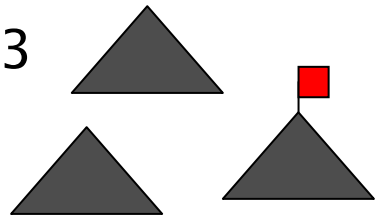
Reclaimed asphalt delivered from site stockpiled

Phase 2



RA is crushed and screened into separate stockpiles

Phase 3



Grading, binder content & properties determined, the stockpile is marked as approved for use in the recycled mix

Mix design procedures

The aim of the mix design is to determine the proportion of new aggregates and RA, as well as the binder content, that will fulfill the requirements of the specification

RA content in mix	Additional binder grades	RA Aggregate quality
< 15%	No change in binder grade	Check intrinsic aggregate properties
> 15%	Determine recovered binder properties of the RA. Use blending chart to decide on appropriate binder grade or if rejuvenator agent required	Check coarse aggregate for strength (ACV, 10% FACT), check fine aggregate quality (sand equivalent)

Proposed RA content in mix	Preparation of RA	Required tests on RA
< 15%	Scalp on the 28 mm sieve. Lightly crush lumps to pass this sieve size	Determine binder content and grading
15% to 30%	Scalp on the 28 mm sieve. Lightly crush lumps to pass this sieve size. Fractionate the RA into 3 sizes: 28 mm to 14 mm, 14 mm to 7.1 mm, minus 7.1 mm	Determine binder content and grading of each fraction of RA
30% to 50%	Scalp on the 28 mm sieve. Lightly crush lumps to pass this sieve size. Fractionate the RA into 3 sizes: 28 mm to 14 mm, 14 mm to 7.1 mm, minus 7.1 mm	Determine binder content and grading. Determine recovered binder properties of each fraction of the RA.

Mix design procedures

Guidelines for maximum RA contents

Type of layer or mix	% RA of new HMA
Wearing course: • SMA • Polymer modified medium graded • Unmodified medium graded	 Less than 3 12 18
Binder course	23
Base course	27

Mixing plant requirements

The same basic types of mixing plants used to produce conventional asphalt mixes are used, but some modifications may be necessary to enable them to produce mix of the same quality as those using all virgin aggregates

Batch type mixing plants

Continuous drum type mixing plants

Mixing plant requirements

RA Content	RA Preparation	Mixing plant requirements		Binder adjustments
		Cold feed	Mixing	
Less than 15%	Fractionating RA is desirable but not essential. Scalp oversize	One cold feed bin is required for the RA if it is not fractionated	Batch plants with separate RA weight hoppers are suitable. Exhaust system modification required for mixes with >10% RA. Parallel-flow and counter-flow drum mixers with RA collars at mid-point of drier drum are suitable	Carry out mix design using normally specified bitumen grade. No change in bitumen grade is normally necessary, but could be changed after reviewing the mix properties
15% to 30%	Crush, screen and fractionate mixes with >20% RA	Cold feed bin required for each RA fraction	Batch plant, with modified exhaust systems, are suitable up to 20% RA. Counter-flow drum mixers with RA collars at mid-point of drier drum are suitable. Parallel-flow drum mixers require separate continuous mixer where the binder is added	Carry out mix design using one grade softer than normally specified bitumen grade. Review binder grade based on the mix properties obtained in the design.
Greater than 30%	Crush, screen and fractionate	Cold feed bin required for each RA fraction	Parallel-flow mixers require separate continuous mixer where the binder is added, exhaust system to be modified. Specialised plants, such as double drum or twin drum mixing plants are required when >40% RA is used in the mix	Ascertain properties of binder recovered from the RA. Carry out mix design with bitumen grade based on combined binder properties

Type of mixing plant	Maximum % RA
Batch mix • Pugmill only • Pugmill and hot elevator	 15 30
Drum mix • Parallel flow feed with aggregate • Parallel flow with centre ring • Counter flow with RA ring • Counter flow with after-mixer	 10 20 20 30
Twin dryer drum	50
Double barrel drum	70

Economic considerations

Besides the environment benefits, the main driver for recycling is that it is economical to do so – offers producers a competitive advantage

- lower virgin aggregate consumption
- lower bitumen consumption
- less bitumen required in the mix
- reduced bitumen transport costs
- maximizes value of RA
- negates waste disposal cost

Economic considerations

Influence of bitumen price and RA content on HMA price