



- PERFORMANCE-RELATED SPECIFICATIONS FOR RAP MIXTURES
- CHARACTERIZATION AND QUALITY CONTROL OF BY-PRODUCTS



# Performance-Related Specifications for RAP Mixes



1. RAP influences both the high- and low- temperature properties of the asphalt binders and the asphalt mixtures (NCHRP studies)
2. The properties of the mixtures containing RAP are mainly influenced by:
  - Aged RAP binder properties
  - Amount of RAP in the mixture
3. The structural performance of recycled mixtures is equal and in some instances better than that of conventional mixtures (Little, Brown, Meyers, Kandhal).
4. The mixtures containing RAP age at a slower rate than the virgin mixture (Kiggundu et al.)



# Performance-Related Specifications for RAP Mixes



## INDIRECT TENSILE STRENGTH:

Higher tensile strength values for the mixtures containing RAP (Kennedy and Perez);

## RESILIENT MODULUS:

The addition of RAP increases the stiffness of the mixtures (Sondag et al.);

## COMPLEX MODULUS:

Addition of RAP to a mixture increases the complex modulus (Marasteanu);

## MIXTURE DURABILITY (moisture susceptibility):

Tensile strength ratio: inclusion of coarse RAP decreases the moisture susceptibility (Stroup-Gardiner);

Marshall stability: RAP does not improve moisture sensitivity of the mixes (Brownie and Hironaka);

## HEATING SUCEPTIBILITY:

Weight Loss after a thermal shock: not significant (Montepara);



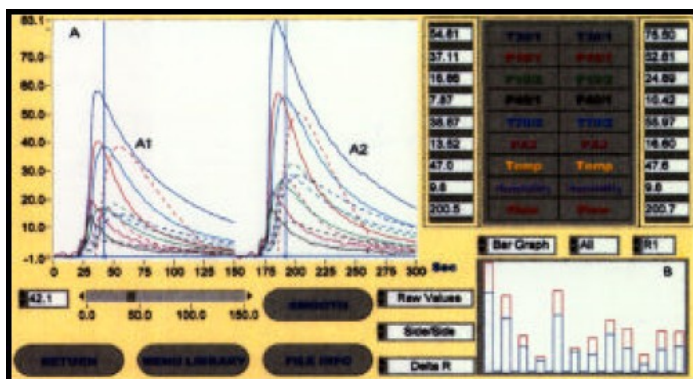
# Characterization and Quality-Control of By-Products



S.I.I.V.



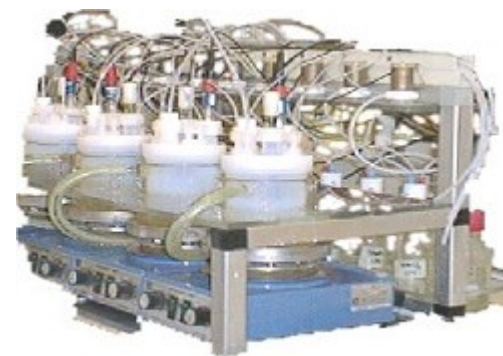
- PREVENT AIR POLLUTION
- PREVENT LOW QUALITY MATERIAL
- PERFORM ANALYSIS “AD HOC” (according to the specific recycling material)



## 2. LEACHING



## 1. SUGAR REFINERIE WASTES





## NEED FOR:



- DEFINING “PERFORMANCE-BASED” SPECIFICATION
- DEFINING A SAMPLING PROTOCOL
- COMPACTION AND CONSTRUCTION SPECIFICATIONS
- QUALITY CONTROL PROTOCOL