

Paper Industry Roundtable Meeting – June 5, 2012

# Recycling “Paper Sludge” into Useful Carbon Products A Progress Report

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- - Definitions and Lab Operations
- - Example Previous Waste Recycling Results
- - Results of “Paper Sludge” Recycling

# Definitions

“To recycle or not to recycle” – Life Cycle Analysis

Paper products are short-lived consumer materials

## Newsprint

- mechanically made; lignin in pulp
- recycling v.s. “waste to energy” difference is small
- recycling reduces deforestation: total energy input reduced

## Office paper

- chemically processed; most lignin removed; burning better than recycling; reduces fossil fuel use

# Lab Operations

Determine % organic in “paper sludge”

High Pressure Reactor

“hydrogen” reagent  
 $\text{CO} + \text{H}_2\text{O}$  or  $\text{HCO}_2\text{Na}$   
“thermal” paper degradation



Product Type Separation

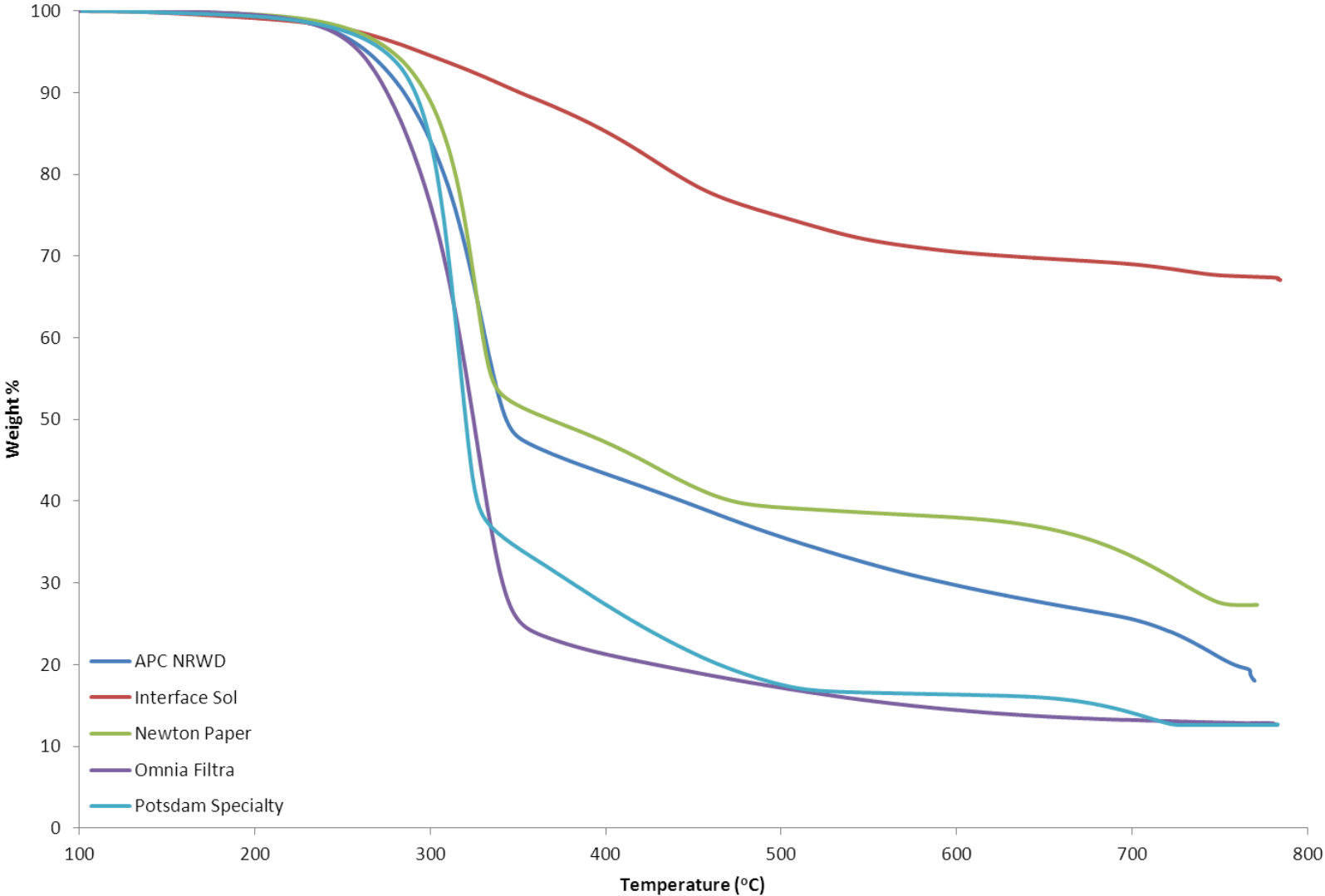
Filter oil from solids  
Solvent extraction  
Distillation



Product Identification

Spectroscopy

# % Organics Paper Samples



# Example Reactor Product Analysis Data

**Input = 200 g. solid waste + 85 g. liquid**

Volatiles vented from reactor

wt = 160 g. liquid

BTU/lb. = 18,500 ± 300

} ~ 75% gas/diesel HC's

(5-30 wt motor oil = ~ 19,000 BTU)

Residue remaining in reactor

Wt. = 120 g.

BTU/lb = 18,000 ± 200

## Reaction Time vs. Yield Data for Sewage Sludge (Gentry) (Fast Heating and Cooling)

T = 350°C., initial CO pressure = 300 psig.

<u>Reaction Time</u>	<u>Yield</u>
1 min.	38.6%
5 min.	22.2%
15 min.	17.3%

## Typical Cracking Experiment Data for Oils from Waste Sludge (Margosian)

<u>Catalyst</u>	<u>Temp.</u>	<u>Yield</u>	<u>Trapped Product</u>
Durabead 8A	500°C	0%	Same as Feed
Durabead 8A	700	5-15	Benzene, toluene, naphthalene
Filtrol 110	700	5-10	Benzene, toluene, naphthalene
Durabead 8A	600	55-55	n-heptane, benzene, toluene
Durabead 8A	600	80-85	n-heptane, benzene, toluene
Filtrol 110	600	50-55	n-heptane, benzene, toluene
Filtrol 110	600	65-70	n-heptane, benzene, toluene
Durabead 8A	600	85-90	n-heptane, benzene, toluene

# Current “Paper Sludge Conversion Results

Reactor at 300°C, 1400-1600 psi

100 gm Potsdam Paper Sludge  
(5 min)



Exp 18	Weight (g)
Org Oil	1.66
Aque	31.28
Solid	15.58

60% organic

50 gm Interface Sol'ns Sludge  
(60 min)



Exp 19	Weight (g)
Org Oil	3.16
Aque	6.1
Solid	34.82

30% organic

100 gm Interface Sol'ns Sludge  
(60 min)



Exp 20	Weight (g)
Org Oil	3.26
Aque	15.36
Solid	66.2

30% organic

# Infrared Spectral Information

