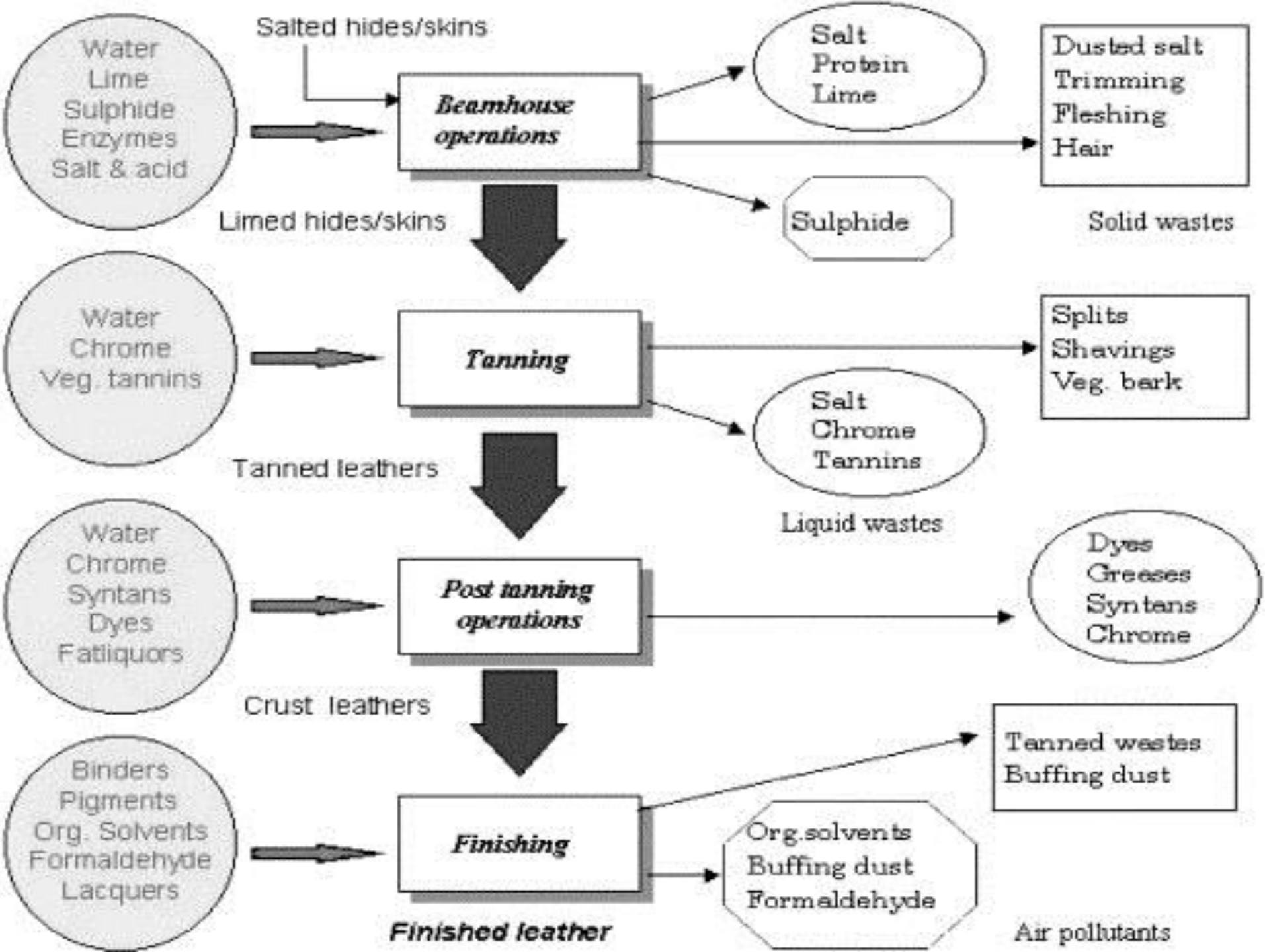
Recycling Leather Wastes in carton Industry

Prof. : Ola A. Mohamed
Tanning materials and leather technology
National research center

- −Leather industry is one of the oldest industries all over the world. Leather is a natural material that, has been used by man for thousands of years.

- – Leather industry is one of the polluting industries because ; generation of huge amount of liquid and solid wastes, also emits obnoxious smell.

– So research must be direct towards investigate the production of useful materials from different kinds of leather wastes.


Water
Lime
Sulphide
Enzymes
Salt & acid
Salted hides/skins
Beamhouse operations
Salt
Protein
Lime
Dusted salt
Trimming
Fleshing
Hair
Sulphide
Solid wastes
Limed hides/skins
Water
Chrome
Veg. tannins
Tanning
Splits
Shavings
Veg. bark
Salt
Chrome
Tannins
Tanned leathers
Liquid wastes
Water
Chrome
Syntans
Dyes
Fatliquors
Post tanning operations
Dyes
Greases
Syntans
Chrome
Crust leathers
Binders
Pigments
Org. Solvents
Formaldehyde
Lacquers
Finishing
Tanned wastes
Buffing dust
Org.solvents
Buffing dust
Formaldehyde
Finished leather
Air pollutants


leather for life
SORTING DEP

➢Solid wastes

Solid wastes generated by the leather industry of may be classified as follows:

1. Wastes from untanned hides/skins (trimmings, fleshing wastes).

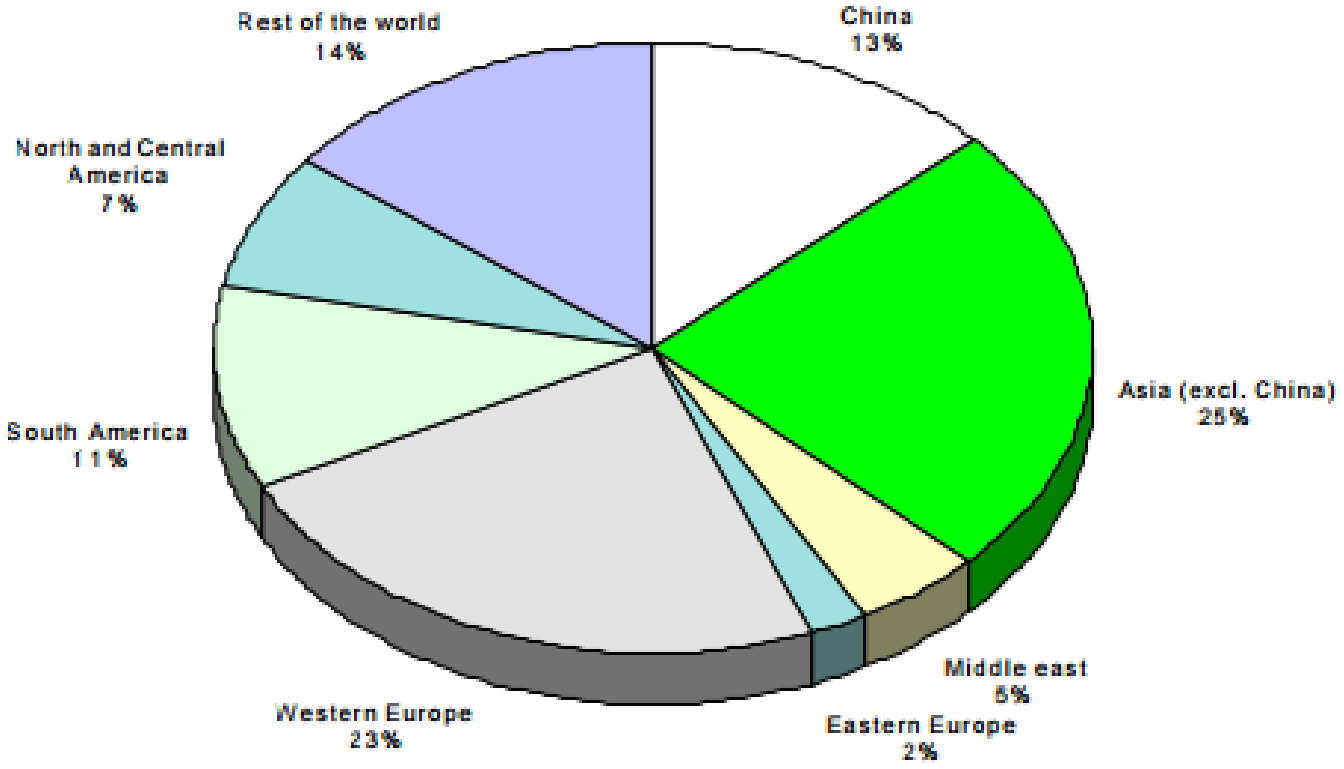
2. Wastes from tanned leather (shaving wastes, buffing dust).

3. Wastes from dyed and finished leather (trimmings from leather).

Table 1: waste ratios regarding the leather manufacturing process

	ratio for heavy bovine	ratio for light bovine leather	ratio for sheep and goat
	(t / million finished leather)	(t / million m² finished leather)	(t / million m² finished
Unusable WB splits, WB shavings and WB trimmings	171	513	180
Dry leather wastes (trimmings,	27.7	83.2	151.3

Figure 1 : wastes generated by the leather manufacturing – % of world areas



Printing and Writing Paper

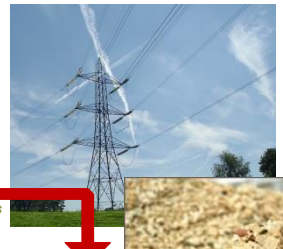
Boxboard

Containerboard

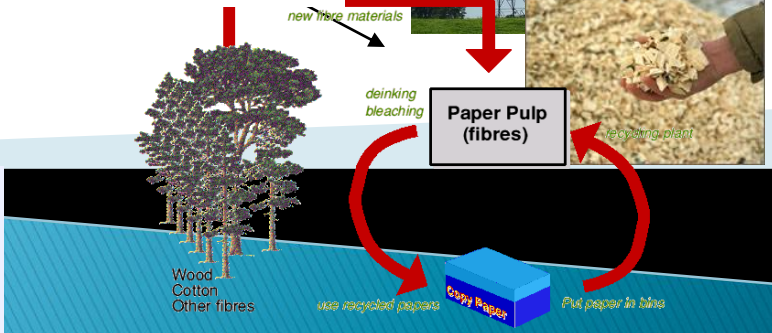
The Pulp & Paper Industry

Newsprint

Tissue Products



Market Wood Pulp



- The word *paper* comes from the ancient Egyptian writing material called papyrus, which was woven from papyrus plants. Papyrus was produced as early as 3000 BC in Egypt, and in ancient Greece and Rome.

- Paper was invented in Ancient China by Ts'ai Lun in AD 105 .

- Global pulp and paper industry dominated by United States, Canada, Sweden, Finland and East Asian countries (such as Japan)
- Australasia and Latin America also have significant pulp and paper industries
- Russia and China expected to be key in the industry's growth over the next few years for both demand and supply

Paper production process

The production process can be divided into 7 sub-processes:

-Raw materials processes.

-Wood-yard.

-Fibre line.

-Chemical recovery.

-Bleaching.

-Paper production.

- products and recycling.

PAPER MAKING PROCESS

Raw Material (Wood)

Debarking
Chipping
Screening

Cooking (Pulping)

Pulp

Washing

Paper Machine

Finishing
Converting

Paper Product

Consumer

Dangers of Fire (United States statistic)

-Someone died in a fire every 3 hrs and someone was injured every 37 minutes.

- 401,000 home fires.

-Residential fires caused more than $6.1billion in property damage.

What is a Flame Retardant?

- A chemical added to combustible materials to render them more resistant to ignition.
- Minimizes the risk of fire starting.
- increases the safety of lives and property.

The main families of flame retardants are based on compounds containing:

-Halogens (Bromine and Chlorine) .

-Phosphorus

-Nitrogen

- Minerals (based on aluminium and magnesium)

- Others (like Borax, Sb_2O_3 , nanocomposites)

-In this study, leather wastes were grinded to nanosize, treated with flame retardants, and then added as filler during the paper sheets formation.

-Using of these wastes help in reduce their hazards and give an economical benefit to paper making and an effective solution for paper firing.

Table 2; Physical and mechanical properties of blank paper sheet as well as the prepared paper sheet containing different concentrations of unmodified leather, 6, 9, and 12 %.

Type of Tests	Blank	Paper sheet with 6%UML	Paper sheet with 9% UML	Paper sheet with 12% UML
Basis weight(g/m^2)	195.55± 4.56	201± 3.97	201.16± 5.4	200.7± 5.09
Tear ($mN.m^2/g$)	0.24± 0.59	0.64± 0.055	0.70± 0.12	0.75± 0.17
Burst ($kPa.m^2/g$)	3.40± 0.22	3.14± 0.44	3.48± 1.49	2.98± 0.26
Thickness (µm)	240± 7.83	238.8± 5.87	281± 28.88	261.8± 8.88
Air permeability ($ml/S.cm^2.Pa$)	0.12± 0.015c	0.19± 0.027	0.24± 0.029	0.25± 0.014
Opacity (%)	99.41± 0.16	99.31± 1.03	99.62± 0.199	99.2± 0.88
Brightness	43.61± 0.01	44.87± 0.65	45.24± 1.1	44.35± 2.40
Breaking length (km)	4.35± 3.6	5.37± 8.63	5.20± 6.71	5.2± 9.5
Elongation (mm)	1.87± 13.16	2.67± 14.70	2.39± 12.12	2.47± 17.36
E-modules (Gpa)	6.2±3.61	5.44± 7.93	4.66± 4.1	4.94± 5.5

Table 3; Physical and mechanical properties of blank paper sheet as well as the prepared paper sheet containing different concentrations of modified leather (MI), 6, 9, and 12 %.

Type of Tests	Blank	Paper sheet with 6%MLI	Paper sheet with 9% ML	Paper sheet with 12% MLI
Basis weight(g/m^2)	195.55± 4.56	198.4± 3.84	193.97± 2.63	199.37± 2.54
Tear (mN.m^2/g)	0.24± 0.59	0.71± 0.06	0.65± 0.042	0.79± 0.11
Burst (kPa.m^2/g)	3.40± 0.22	3.28± 0.21	2.93± 0.27	2.89± 0.18
Thickness (µm)	240± 7.83	259.8± 4.1	261.8± 3.29	273.4± 5.10
Air permeability (ml/S.cm^2.Pa)	0.123± 0.015	0.243± 0.013	0.293± 0.013	2.8± 8.9
Opacity (%)	99.41± 0.16	97.88± 0.143	99.73± 0.12	99.69± 025
Brightness	43.61± 0.01	44.79± 0.91	44.68± 0.72	44.99± 1.08
Breaking length (km)	4.35± 3.6	5.61± 0.48	4.5± 0.47	4.77± 0.48
Elongation (mm)	1.87± 13.16	2.61± 0.086	2.46± 0.46	2.68± 0.69
E-modules (Gpa)	6.2±3.61	5.23± 0.36	4.78± 0.25	4.3± 0.49

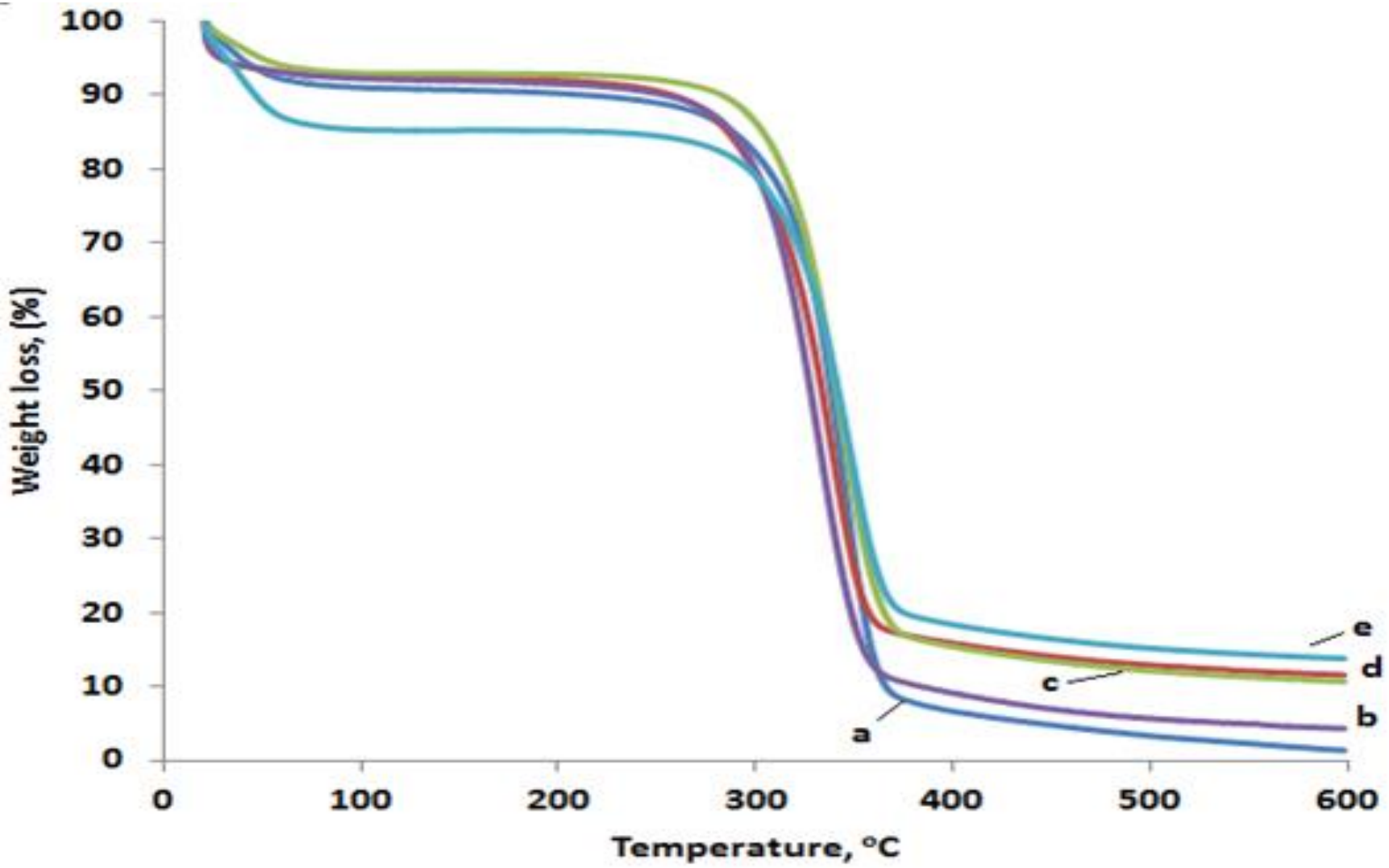
Table 4; Physical and mechanical properties of blank paper sheet as well as the prepared paper sheet containing different concentrations of modified leather (MII), 6, 9, and 12 %.

Type of Tests	Blank	Paper sheet with 6%MLII	Paper sheet with 9% MLII	Paper sheet with 12% MLII
Basis weight(g/m^2)	195.55± 4.56	200.28± 4.22	203.38± 3.54	199.37± 2.54
Tear ($mN.m^2/g$)	0.24± 0.59	0.80± 0.145	0.76± 0.10	0.712± 0.69
Burst ($kPa.m^2/g$)	3.40± 0.22	3.27± 0.16	3.09± 0.178	2.48± 1.11
Thickness (µm)	240± 7.83	259.8± 4.1	261.8± 3.29	273.4± 5.10
Air permeability ($ml/S.cm^2.Pa$)	0.123± 0.015	0.218± 0.18	0.212± 0.098	0.25± 0.168
Opacity (%)	99.41± 0.16	99.71± 0.112	98.96± 0.86	98.91± 0.17
Brightness	43.61± 0.01	45.83± 0.733	46.69± 0.425	46.65± 0.504
Breaking length (km)	4.35± 3.6	5.27±8.85	5.41± 7.72	5.8± 0.48
Elongation (mm)	1.87± 13.16	2.16±14.92	2.6± 19.13	2.21± 0.435
E-modules (Gpa)	6.2±3.61	5.38±5.19	5.33± 4.26	4.77± 0.269

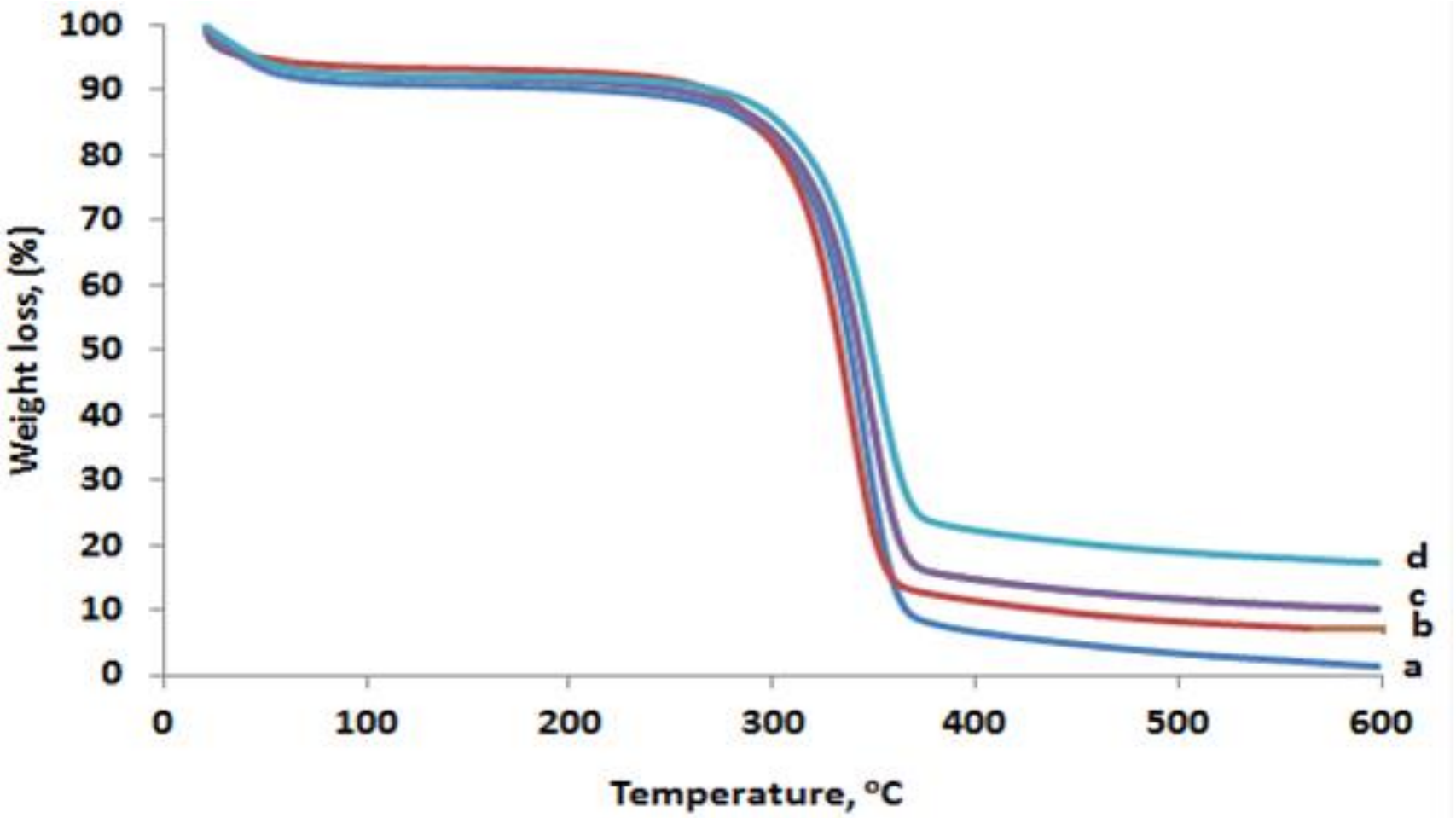
Table, (5) : Flame retardant and burning length of the paper sheets

Sample	Flame time (s)	Burning Length (mm)
Blank	4	150
Untreated		
3%	6	150
6%	7	150
9%	Not ignited	-
12%	Not ignited	-
Treated I		
3%	6.5	150
6%	7	150
9%	Not ignited	-
12%	Not ignited	-
Treated II		
3%	6	150
6%	8	-

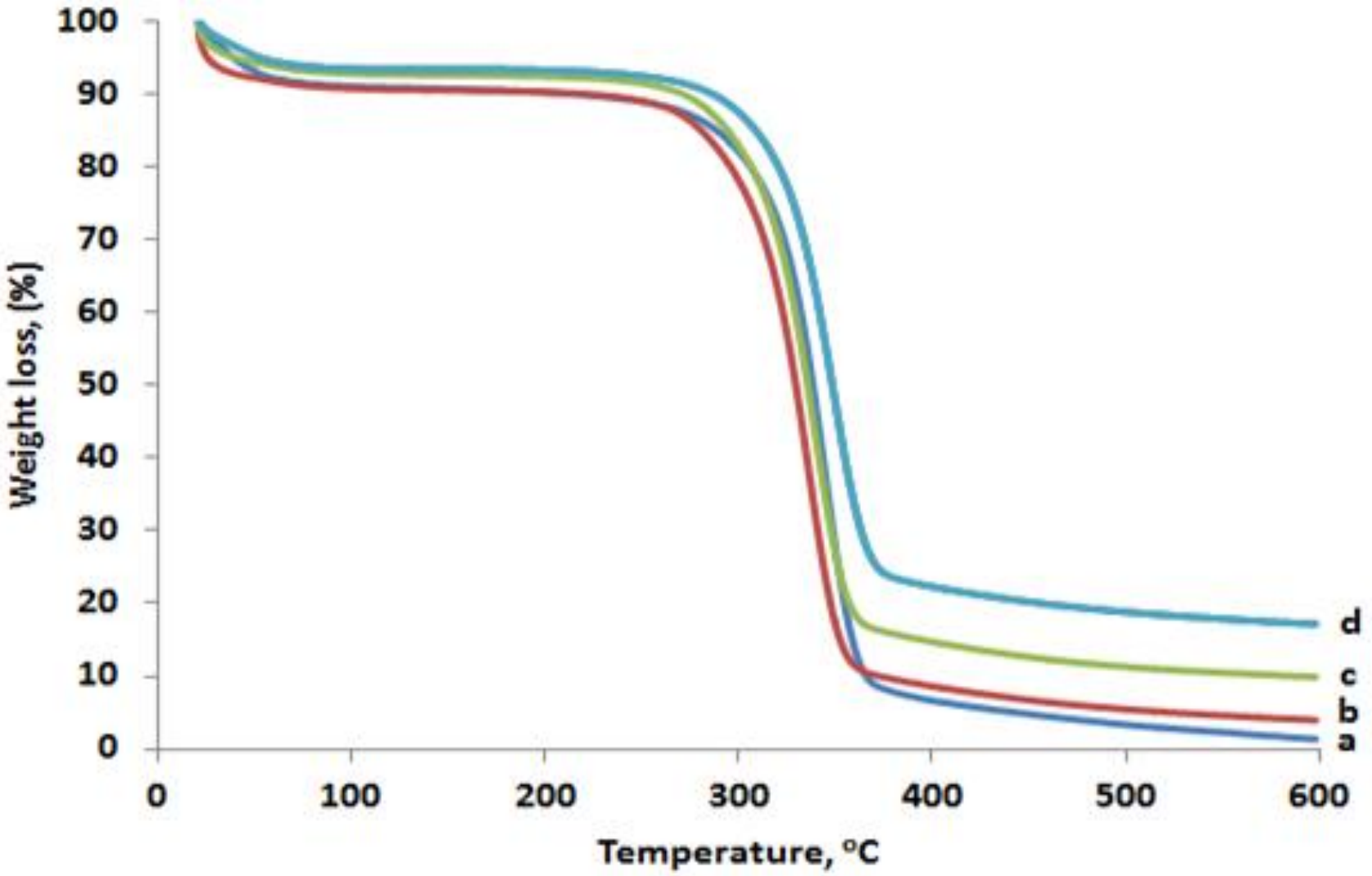
TGA of a) blank, b) 3% untreated leather, c) 6% untreated leather, d) 9% untreated leather, e) 12% untreated leather



TGA of a) blank, b) 6% treated I, c) 9% treated I, d) 12% treated I

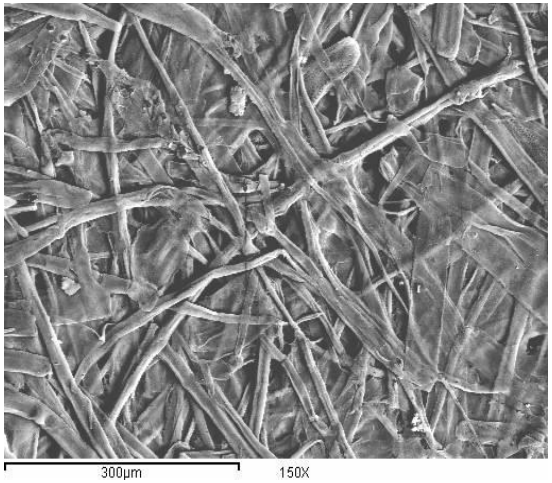


TGA of a) paper sheet as well as, b) 3% treated II, c) 6% treated II, d) 12% treated II

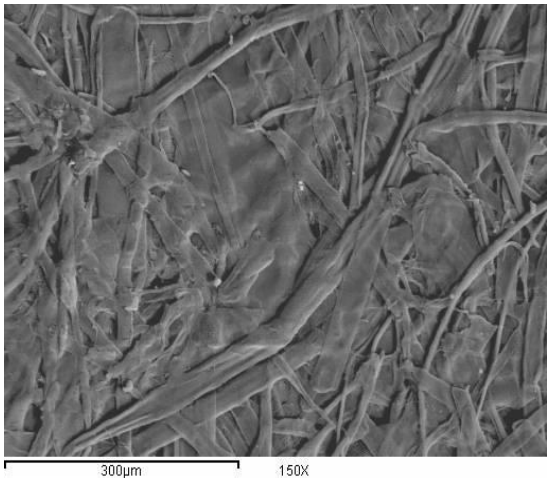


SEM images of : a) Blank paper sheet as well as paper sheet with untreated and treated

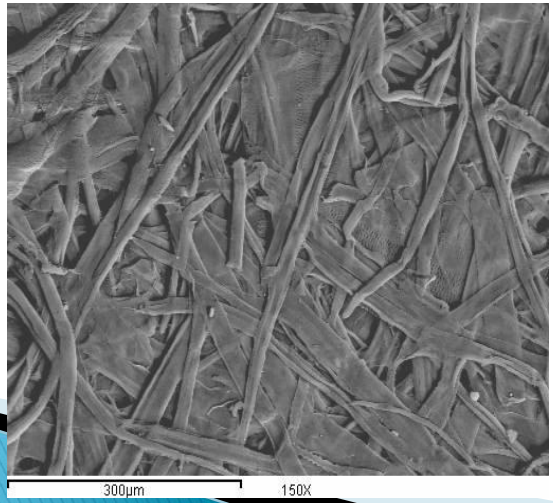
a)



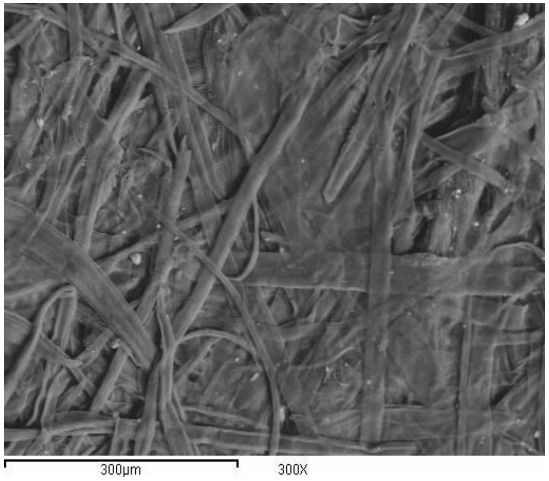
b)



c)



d)



Conclusion:

- These results showed that the addition of leather wastes has improved significantly the flammability properties, in the same time didn’t have a bad effect on the visual, physical and mechanical properties.

-This approach can be also extended to various fields of chemistry such as polymers and rubbers.


Thank You