

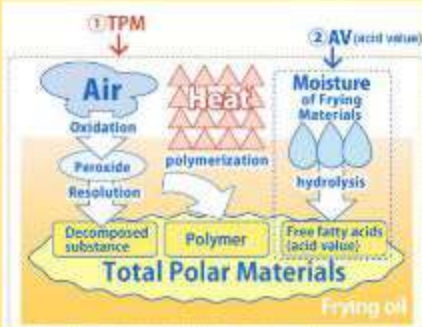
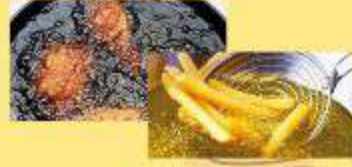
BRINGING INTO USE OF WASTE FRYING OILS AGAIN BY PHOTOCATALYTIC METHOD: TPC PURIFYING CONTAINER DESIGN



Boran Duman
bduman24@my.aci.k12.tr
American Collegiate Institute

WHAT IS TOTAL POLAR COMPOUND?

- Frying is one of the most popular cooking processes in the world and it is defined as cooking of food items in (150-190°C) oil.
- This process causes chemical and physical reactions to take place in the oil. These reactions induce a change in viscosity, darkening of color, foaming, and a change in the oil's smoke point.



- As a result of all these reactions, a large number of Total Polar Compounds are formed.
- Frying oils which are exposed to high temperatures for a long time and used repeatedly form various harmful compounds for human and environmental health.
- Polar substances can alter carbohydrate, protein, and lipid metabolisms. Thus, they create toxicological, cytotoxic and carcinogenic effects. This may cause various diseases.
- 25% of water pollution is sourced by waste oil disposal.



INTERNATIONAL LEGISLATURE:

- In terms of TPC amount in frying oils, governments have felt it necessary to set restrictions on them. In The European Union, the maximum TPC amount has been set between 24-26% by experts.
- This limit value is 24% in Germany; 25% in Turkey, Belgium, France, Portugal, Italy and Spain; 27% in Australia, China and Switzerland.
- So, it is important to be aware of the TPC value of the frying oil that we are using frequently.

USE OF PHOTOCATALYSIS:

- Photocatalysis is nanotechnology targeted systems based on the interaction of light and solid semiconductor particles.
- A photocatalyst is defined as a semiconductor that becomes active when interacting with light, forming strongly oxidizing and/or reducing active surfaces.
- Metal oxides and sulphides are generally used as semiconductor photocatalysts in photocatalytic degradation systems (TiO₂, ZnO, Fe₂O₃, etc.).
- The photocatalyst creates radicals (oxide, peroxide and hydroxyl), which are strongly oxidizing species, on its surface with the effect of light it absorbs.
- By the breakdown of such harmful organic molecules, harmless species such as water and carbon dioxide are formed.
- TiO₂ nanoparticles; it is frequently preferred as a photocatalyst because it is resistant to chemical corrosion and photocorrosion, non-toxic, insoluble in water and low cost.



OUR AIM:

- In this project we aimed to design a container which will decrease the TPC content in a used frying oil, purify it, and bring waste frying oils into use again by using photocatalytic feature of TiO₂ nanoparticles under UV light.



METHODOLOGY:

- Supply of Oils that are used in Experimental Set-ups:
 - Habitat Recycling and Environment Industry, the natural waste oil collection company of the Ministry. Trade Ltd. Company was obtained from Bornova 1st Class Collection Center.
 - TiO₂ Plating On Pyrex (Borcam) Containers:
 - Glass container was plated with TiO₂ solution by spraying technique.
 - Heated in oven for 40 minutes at 500 degree.
 - After the TiO₂ coated on the glass container became completely translucent, it was allowed to cool in a controlled manner.



METHODOLOGY:

- Parameter of TPC Purifying with Photocatalytic Effect:
 - 2 different wavelength of UV light effect (365-395nm)
 - UV Light intensity Effect (9 LED-21 LED)
 - Temperature change effect (22 0C- 55 0C)
 - Initial TPC amount effect (15,5 TPM - 11,5 TPM)

	UV		Temperature	
	365nm	395nm	55°C	22°C
Set-up-1	X		X	X
Set-up-2		X	X	X
Set-up-3		X		X
Set-up-4	X			X
Set-up-5			X	X
Set-up-6		X (21 LED)	X	X
Set-up-7		X (21 LED)	X	X
Set-up-8	X		X	X
Set-up-9	X (High TPM)		X	X
Set-up-10	X (High TPM)		X	X

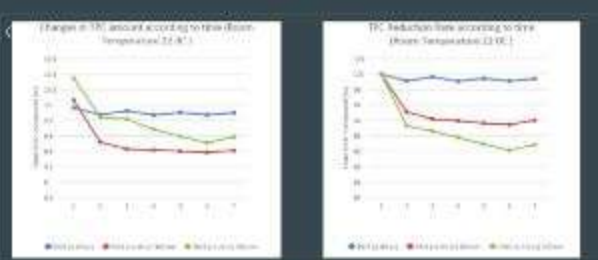


RESULTS OF OUR EXPERIMENTS:

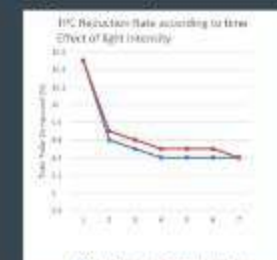
Results: Effect of Different Wavelength of UV Light on TPC Purification.



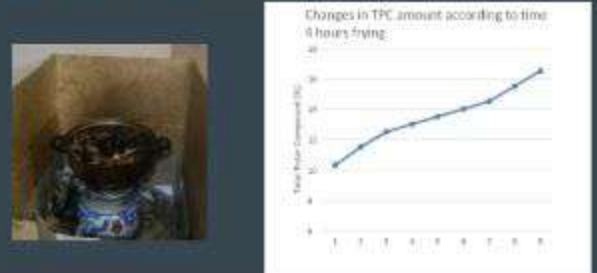
Results: Effect of Different Wavelength of UV Light on TPC Purification.



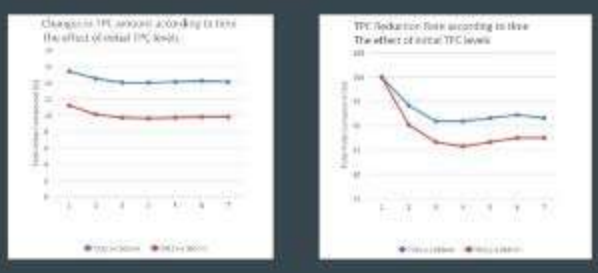
Result: Effect of Light Intensity.



Result: Effect of Initial TPC Amount.



Result: Effect of Initial TPC Amount.



CONCLUSION:

- Roughly 1 litre waste oil pollute 1000 ton of clean water.
- Additionally, disuse or leaving the use of frying oils that have not reached the status of waste oil causes a significant wastage and leads to have a negative impact on economy.
- In this regard, it is highly significant and advantageous to lengthening the usage time of frying oils for the sake of protection of the environment, human health and economy.

- After one-time frying, the amount of TPC in the oil increases by 3.8%.
- In our study, we found a 1% decrease in TPC level with 3-hour UV application. It means 10% reduction on average compared to the baseline level.
- With the extension of the time, the TPC level that has increased after frying can reach the pre-use level.
- As a result, we think that by extending the usage period of the frying oils used with the product we designed in our project, it will contribute to the protection of the ecosystem by reducing both the economy and environmental pollution