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Chemical Stability of Consumables

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Abstract

Consumables such as Eppendorf tubes and pipette tips have to withstand the different kinds of stress and strain encountered in everyday laboratory work, e.g. when centrifuging and autoclaving, and at the same time are exposed to chemical reactions. Their level of stability to these effects is, to a large degree, determined by their material and its processing during manufacture. As a leading manufacturer of biotech products, Eppendorf uses PP and PE granulates specifically suited for the laboratory application and manufacturing process of its micro test tubes, Combitips and tips.

Chemical interactions with consumables

Chemicals interact with consumables in a number of different ways. These include:

1. The chemical reaction with the polymer, e.g. by oxidation, reaction with the functional group, and by depolymerization.
2. Dissolving the synthetic material with a solvent or introducing the solvent into the synthetic material to induce swelling and a change in the material's mechanical properties.
3. The formation of tension cracks resulting from mechanical stress and surface-active substances (detergents, oils). The stress can be caused by internal forces (inherent material stress) or as a consequence of an external process (centrifugation).

Potential Applications

In many applications it is necessary to dispense acids, bases, solvents and salt solutions with varying densities, vapor pressures and viscosities; whereby their properties differ considerably from that of water. Such substances influence the chemical resistance of the materials with which contact is made. Prior to using a dispensing system two questions must thus be answered:

1. How great are the dispensing errors resulting from the physical properties of the liquids?
2. Is the pipette tip or the Combitip tight during dispensing despite the chemical influences and will the pipette or dispenser remain resistant for a protracted period of time?

Chemical Stability

Consumables are generally made of polypropylene (PP) or polyethylene (PE). For both thermoplasts the relevant literature contains extensive information about chemical resistance. It attests a high level of chemical resistance for both PP and PE [1]. According to this reference work, conditional stability is still attributed to a plastic, for example, even though it may be damaged by uninterrupted contact with a chemical for a period of weeks. As meaningful as this data may be for the storage of materials in plastic tubes, it does not reflect conditions prevalent for the much shorter contact times involved with dispensing. Liquids to which PP or PE are only conditionally resistant according to the literature such as inorganic acids and various organic acid solvents such as acetone, diethyl ether, chloroform or toluene can be dispensed without a problem. The prerequisite here is that the contact time is minimized, i.e. the plastic is not used for uninterrupted series pipetting, and the liquid is not additionally heated. As regards the resistance of pipette and dispenser tips, it is a basic rule that the expected dispensing error will increase the longer a consumable is used for the above chemicals. However, it remains surprisingly low for many substances. The following classification can therefore only provide some general information. When in doubt, a test should be carried out. Our information concerning autoclavability (121 °C, 20 min) for Eppendorf consumables should also be taken into account. The greatest degree of safety is obtained by using the disposable tips and tubes only once.

Materials in selected Eppendorf products

PE = Polyethylene, PP = Polypropylene, PC = Polycarbonat, auto-clavable

epT.I.P.S.

	PE	PP	PC	autoclavable
All tips		●		●

epT.I.P.S. Box, epT.I.P.S. Reloads

	PE	PP	PC	autoclavable
Box: min. autoclavable at least 100 times			●	●
Reloads: autoclavable		●		●

ep Dualfilter T.I.P.S.

	PE	PP	PC	autoclavable
Tip:		●		
Filter: hydrophobic	●			
Rack + Tray:		●		

Eppendorf Mastertip

	PE	PP	PC	autoclavable
Piston:	●			
Cylinder:		●		
Rack:		●		
Temperatures >121 °C lead to deformation of the Mastertip piston				●

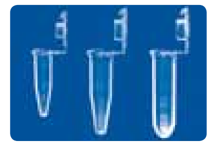
Eppendorf Varitip P/S, Maxitip G

	PE	PP	PC	autoclavable
Piston:	●			
Cylinder:		●		
Valve: Polyvinylfluoride				
Maxitip G:				●

Combilong, Tip-Tub

	PE	PP	PC	autoclavable
Combilong:		●		●
Tip-Tub:		●		●

Tubes (3810X, Eppendorf Safe Lock, LoBind)



	PE	PP	PC	autoclavable
All tubes		●		
When lid open				●

Eppendorf Plate (DWP and MTP)

	PE	PP	PC	autoclavable
Eppendorf Plate (DWP and MTP)		●		

Eppendorf Combitips advanced

	PE	PP	PC	autoclavable
Cylinder		●		
Piston	●			
Adapter for 25 mL and 50 mL		●		●

Combitip Rack

	PE	PP	PC	autoclavable
Combitip Rack		●		●

epT.I.P.S. Racks (Eppendorf Biopur/LoRetention)

	PE	PP	PC	autoclavable
epT.I.P.S. Racks		●		

epT.I.P.S. Singles (Eppendorf Biopur)

	PE	PP	PC	autoclavable
epT.I.P.S. Singles		●		

Eppendorf epT.I.P.S., Tubes and Combitips advanced are also available in Eppendorf Biopur quality, i.e. sterile, free of RNase, DNase and PCR inhibitor, human and bacterial DNA, Pyrogen and ATP. epT.I.P.S., Tubes and Combitips advanced are also available in PCR clean quality, i.e. free of human DNA, DNase, RNase and PCR inhibitor.

Chemical resistance of PP and PE

Chemicals	Concentration in %	Other names	Temperature °C	PE*1	PP*2	PC*3	Steam pressure at 20 °C (hPa)	Density at 20 °C (mg/µL)	Viscosity at 20 °C (mPas)	Remarks
Acetaldehyde	40	Ethanal	20 60	0 3	1 1	3	1006	0.78		
Acetic acid	25–60	Ethane acid	40 60	1 1	1 1	0		1.06	1.22	
Acetone	100	Dimethylketone	20 60	2 3	1 2	3	246	0.79		
Ammonium hydroxide	30		60	1	2	0	483	0.89		
Aniline	100		20 60	1 1	1 1	3		1.02	4.4	
Benzene	100		20 60	2 3	2 3	3		0.88		
Benzine	100		20 60	2 3	2 3	2				
Butanol	up to 100	Butyl alcohol	20 60	1 2	1 2	1		0.81		
Chloroform	100	Trichlormethane	20 60	2 3	2 3	3	213	1.47		
Diethyl ether			20 60	2 3	2 0	3	587	0.71		
Dimethylformamide	100		20 60	1 2	1 1	3		0.94		
Dioxane	100		20 60	1 2	2 2	3		1.03	1.32	
Ethanol	96	Ethyl alcohol	20	2	2	1	58	0.8	1.52	
Ethyl acetate	100		20 60	1 2	1 2	0	98	0.9		
Formaldehyde	40	Methanal	40 60	1 1	1 1	1				
Formic acid	85	Methanoic acid	20 60	1 1	1 2	0		1.19	1.4	
Glycerol	each		60	1	1	2		1.26	1480	
Hydrochloric acid	37		20 60	1 2	1 1	2	190	1.18	1.9	
Hydrofluoric acid	up to 40		20 60	1 1	1 1	3		1.14		Warning! Corrosive! Attacks the ceramic piston of the pipette.
Isopropanol	each	Isopropyl alcohol	60	1	1	2	43	0.78		
Methanol	100	Methyl alcohol	40 60	1 2	1 1	0	129	0.79		
Methylene chloride	100	Dichlormethane	20 40	3 3	2 3	3	475	1.3		
Nitric acid	65		20 60	3 3	3 3	3		1.51	1.77	Pipette must be adjusted
Perchloric acid	70		20 60	1 3	0	0		1.68		Pipette must be adjusted
Petroleum ether	100		20 60	2 2	1 2	2	58			
Phenol	90		20 60	1 2	1 1	2		1.07		
Phosphorus acid	80		20 60	1 1	1 1	0		1.69	30	Pipette must be adjusted
Pyridine	100		20 60	1 2	2 2	3	20.5	0.98		
Sodium hydroxide	up to 40		40 60	1 1	1 1	3		1.43	37	
Sodium hypochlorite			20 60	2 3	1 2	0		1.2		
Sulfuric acid	96		20 60	2 3	2 3	3		1.84	27	Pipette must be adjusted
Tetrachlormethane	100	Carbon tetrachloride	20 60	3 3	3 3	3	120	1.59		Pipette must be adjusted
Tetrahydrofuran	100		20 60	3 3	2 3	3	173	0.89		
Toluene	100		20 60	2 3	2 3	3		0.87		
Trichloroacetic acid	100	TCA	20 60	2 3	1 1	3		1.61		Pipette must be adjusted
Trichlorethene	100		20 60	3 3	2 2	3	78	1.46		Pipette must be adjusted

*1 PE = Polyethylene; *2 PP = Polypropylene; *3 PC = Polycarbonate
1 = resistant; the material does not change even after longer contact with the appropriate substance.
2 = conditionally resistant; if the material gets in contact with the substance only for a short time it does not change.
3 = non-resistant; the material already changes after a short contact with the substance.
0 = no existing value.
Source: Carlowitz, B.: Kunststofftabellen. 4. Aufl. München: Hanser, 1995.-ISBN 3-446-17603-9.

References:

[1] Carlowitz, B.: Kunststofftabellen. 4. Aufl. München: Hanser, 1995.-ISBN 3-446-17603-9.

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