

Central Lancashire Online Knowledge (CLOK)

Title	3D printed oral theophylline doses with innovative 'radiator-like' design: Impact of polyethylene oxide (PEO) molecular weight
Type	Article
URL	https://clock.uclan.ac.uk/28342/
DOI	https://doi.org/10.1016/j.ijpharm.2019.04.017
Date	2019
Citation	Isreb, Abdullah, Baj, Krzysztof, Wojsz, Magdalena, Isreb, Mohammad, Peak, Matthew and Alhnan, Mohamed A (2019) 3D printed oral theophylline doses with innovative 'radiator-like' design: Impact of polyethylene oxide (PEO) molecular weight. International Journal of Pharmaceutics, 564. pp. 98-105. ISSN 0378-5173
Creators	Isreb, Abdullah, Baj, Krzysztof, Wojsz, Magdalena, Isreb, Mohammad, Peak, Matthew and Alhnan, Mohamed A

It is advisable to refer to the publisher's version if you intend to cite from the work.
<https://doi.org/10.1016/j.ijpharm.2019.04.017>

For information about Research at UCLan please go to <http://www.uclan.ac.uk/research/>

All outputs in CLOK are protected by Intellectual Property Rights law, including Copyright law. Copyright, IPR and Moral Rights for the works on this site are retained by the individual authors and/or other copyright owners. Terms and conditions for use of this material are defined in the <http://clock.uclan.ac.uk/policies/>

Table 1 Composition, processing temperatures and FDM 3D printing compatibility of theophylline filament including PEO of different molecular weights.

Filament	Composition	HME		FDM 3D Printing Temp. (°C)	Compatibility with the gears of FDM 3D printer head
		Processing Temp. (°C)	Extrusion Temp. (°C)		
Fil K100	Theophylline:PEG 6K: PEO 100K 30:35:35	60	60	NA*	Too fragile
Fil K200	Theophylline:PEG 6K: PEO 200K 30:35:35	65	65	105	Fragile
Fil K300	Theophylline:PEG 6K: PEO 300K 30:35:35	70	70	110	Compatible
Fil K600	Theophylline:PEG 6K: PEO 600K 30:35:35	80	80	145	Compatible
Fil K900	Theophylline:PEG 6K: PEO 900K 30:35:35	80	80	NA**	Compatible

* Filaments were incompatible with FDM 3D printer due to frequent filament breakage.

** Filaments were incompatible with FDM 3D printer due to immediate nozzle blockage.

Table 2 Hansen solubility parameter in MPa^{1/2} and components due to theophylline and PEO/PEG.

Where δ_D , δ_P and δ_H are the dispersion, polar, and hydrogen components of solubility parameter and (HSP) Hansen solubility parameter.

	δ_D	δ_P	δ_H	HSP
Theophylline	19.7	15.4	10.5	27.1
PEO, PEG	17	10	5	20.3

Table 3 Dimensions, volume of CAD designs, mass and surface/mass ratios of caplet and radiator-like structures generated by FDM 3D printing.

Design	CAD design dimensions (mm)			CAD design volume (mm)	CAD design surface (mm ²)	Mass (mg)	Surface /mass ratio (mm ² /mg)	Drug contents (mg)
	X	Y	Z					
Caplet	12	4.75	4.36	188.33	184.07	172.78±4.8	1.07	51.7±2.2
Radiator-2 mm spaced	20	10	5.99	141.47	1464.39	187.7±3.9	7.80	52.4±1.7
Radiator-1.5 mm spaced	19.679	10	5.99	170.46	1705.64	196.2±5.9	8.69	53±0.7
Radiator-1 mm spaced	19.93	10	6.03	231.35	2211.34	247.86±3.5	8.92	74.5±0.6
Radiator-0.5 mm spaced	19.433	10.	5.99	262.16	2557.66	290±7.9	8.82	80.1±0.7