Sartopore® Platinum Gamma Filter Elements

Extractables Summary Report

SARTORIUS

Table of Contents

Tables

1. Introduction

The potential exists for certain compounds of polymeric materials used in production or storage of active pharmaceutical ingredients (APIs) or drug products to leach into the contacting process fluids. Therefore, polymeric materials for pharmaceutical use must meet applicable industry and regulatory standards and requirements. It is mandatory to ensure that no toxic or other undesired compounds enter the drug substance or drug product.

The Code of Federal Regulations (CFR), Title 21, Part 211.65 states: "Equipment shall be constructed so that surfaces that contact components, in-process materials, or drug products shall not be reactive, additive, or absorptive so as to alter the safety, identity, strength, quality, or purity of the drug product."

Consequently, extractable substances are addressed as part of a material safety qualification program for single-use systems in biopharmaceutical manufacturing.

Sartorius Stedim single-use systems are subject to comprehensive extractables testing applying both in-house standards,[1,2] and published biopharma end-user recommendations[3]. Extractables Guides presenting the methodologies and results of our in-house studies are available for our customers by product family.

[1] Menzel, R., Pahl, I., Loewe, T., Hauk, A.: "Comparative Extractables Study of Autoclavable Polyethersulfone Filter Cartridges for Sterile Filtration", PDA J Pharm Sci and Tech accepted Dec. 2017

[2] Pahl I., Dorey S., Barbaroux M., Lagrange B., Frankl H.: "Analysis and Evaluation of Single-Use Bag Extractables for Validation in Biopharmaceutical Applications", PDA J Pharm Sci and Tech 2014, 68, pp 456–471

[3] Ding, W., Madsen, G., Mahajan, E., O´Connor, S. and Wong, K.: "Standardized Extractables Testing Protocol for Single-Use Systems in Biomanufacturing", Pharmaceutical Engineering, Vol. 34, No. 6, 2014, pp.1–11

2. Test Scope

This study was designed to represent a biopharma-related extractables profile for gamma Sartopore® Platinum filter elements.

According to the end-user recommendation as described by Ding et al., six different extraction solutions (water, 50% EtOH, 1% polysorbate 80, 5 M NaCl, 0.5 N NaOH and 0.1 M H_3PO_4) were used. The extraction of the basic filter element and housing were performed according to the Sartorius component-based approach. Extraction with the six different test solutions was performed at ambient temperature for 30 min and at 40 °C for one day and seven days. No pre-flushing was performed. The test articles were subjected to extraction within three to five weeks after gamma irradiation at a dose of a minimum of 50 kGy. Two different lots of basic filter elements and housings were tested. The results of the lot which showed the higher level of the respective extractable compound are reported. Relevant product information, as well as the extraction conditions, are shown in Table 1.

The resulting extracts were analyzed by headspace gas chromatography coupled with mass spectrometry (HS GC-MS), liquid injection gas chromatography coupled with a mass spectrometer (GC-MS) and liquid chromatography coupled with a high-resolution mass spectrometer (LC-HRMS). The summary of organic extractables is shown in Table 10. If a substance is **'confirmed'** by HS GC-MS or GC-MS analysis, the authentic reference compound (if commercially available) is measured together with the internal standard.

The concentration of all other compounds with identification levels **'confident'** and **'tentative'** is estimated from peak area ratios of standard substance and the peak in question (semi-quantification). For that purpose, the following assumption is made: the response factor of the compound and the internal standard are identical. For the LC-HRMS, target analysis quantification was carried out with authentic reference standards using a multi-point calibration. The results for elemental impurities analyzed with an inductively coupled plasma mass spectrometer (ICP-MS) are shown in Table 14. An external calibration with different multi-component standard solutions was performed.

The sensitivity of an analytical method strongly depends on the type of analyte, the sample matrix and the equipment itself. Therefore, reporting limits (RL) are established to the lowest but reasonable level to secure a safe and reliable identification of the extractables. The reporting limits are given in Tables 6–9.

3. Test Materials and Extraction Conditions

Table 1: Information of the testing material and conditions of the extraction

Test Article[1]	Basic Filter Element: Filter Housing:	Gamma Sartopore® Platinum Gamma Capsules
Number of Test Articles	Basic Filter Element: Filter Housing:	2 2

Pretreatment	**Variables**	**Units**	**Values**
Gamma irradiation	Dose	kGy	55.98 (F) 52.08 (H)
Autoclave	Time, temperature, number of cycles	Minutes, °C, #	N/A
Pre-flush	Fluid identity, duration, temperature, volume name	Minute, °C, L	None

Test Article Extraction Conditions	**Variables**	**Units**	**Values**
	Temperature	°C	40 °C
	Duration	Minutes, hours, days	> 30 min, 24 h, seven days
	Solvent contact surface area	cm^2	1300 (Filter)[2] 1000 (Maxicaps® Housing)[3] 630 (Midicaps® Housing)[4] 150 (Capsule Housing)[5]
	Solvent volume	mL	1300 (Filter) 1000 (Maxicaps® Housing) 630 (Midicaps® Housing) 60 (Capsule Housing)
	Surface area to volume ratio	cm^2/mL	1 (All) 2.5 (Capsule Housing)

Supporting Information			
	EFA Basic Filter Element	m^2	0.13
	Time between irradiation and extraction	Weeks	≤ 5
	Typical dose range	kGy	25 to ≤ 50

Abbreviations: N/A = not applicable; EFA = effective filtration area; (F) = basic filter element; (H) = filter housing

[1] Basic filter element and filter housing were extracted separately according to the Sartorius Stedim Biotech component approach
[2] Gamma Sartopore® 2 XLM basic filter element size 8
[3] Gamma Maxicaps® housing size 1
[4] Gamma Midicaps® housing size 0
[5] Mini capsules size 5

4. Overview Effective Filtration

It is generally accepted that the quantity of extractable substances is proportional to the product contact area for a filter cartridge expressed by the effective filtration area (EFA). This means that in non-equilibrium conditions (one-day extraction time), extractable results for one specific size of a filter element can be used to calculate the amount of the extractables of another size of the same type (same material) using the relationship of the surfaces. This is valid likewise for the membrane support material and the housing components.

Based on the obtained extractables data and the surface relation, (semi)quantified extractables values for all the different types and sizes can be calculated based on the tested samples. The required information of the different EFAs and surfaces can be found below in Tables 2–5.

Table 2: Effective filtration area (EFA) of base elements

Filter base elements

Size	EFA [cm²]	Employed in housing type
4	210	Gamma Mini Capsules
7	650	Gamma Midicaps®
8	1,300	
9	2,600	
0	5,200	
1	10,000	Gamma Maxicaps® and T-Style Maxicaps®
2	20,000	
3	30,000	

Table 3: Surface of the capsule housings

Mini capsule housing

Size	Surface [cm²]
4	75

Table 4: Surface of the gamma Midicaps® housings

Gamma Midicaps® housing

Size	Surface [cm²]
7	190
8	250
9	350
0	630

Table 5: Surface of the gamma in-line Maxicaps® and -Style Maxicaps® housings

Gamma Maxicaps® housing

Size	Surface [cm²]
1	1,000
2	1,700
3	2,400

5. Analytical Parameters

Table 6: Assay performance parameter for liquid chromatography with mass detection (LC-HRMS)

Standards	Bisphenol A (BPA), Pentaerythritol tetrakis(3,5-di-*tert*-butyl-4-hydroxyhydrocinnamate) and	or Caprolactam
Limit of detection	S/N ≥ 3
Reporting limit	0.1 µg/cm²
Precision	1 ppm BPA, RSD ≤ 20%
Spike recovery	80 – 120%
Sample bracketing	Injection of standard at least every 10 samples
Column	C18
Column temperature	40 °C
Mobile phase A	Acetonitrile
Mobile phase B	10 mM Ammonium acetate
Mass range	50 – 1500 amu
Ionization modes	ESI positive and negative ionization and	or APCI positive and negative ionization

Abbreviations: S/N = signal-to-noise ratio, RSD = relative standard deviation, amu = atomic mass units, ESI = electrospray ionization, APCI = atmospheric pressure chemical ionization

Table 7: Assay performance parameter for gas chromatography with mass detection (GC-MS)

Standards	*n*-Dodecane, Butylated hydroxytoluene (BHT) and	or: Caprolactam, 1,3-Di-*tert*-butylbenzene, Diisobutyl phthalate
Limit of detection	S/N ≥ 3
Reporting limit	0.1 µg/cm²
Internal standard	2-Fluoro-1,1'-biphenyl
Sample preparation	Liquid-liquid extraction with DCM 1:1
Precision	1 ppm BHT, RSD ≤ 20%
Spike recovery	80 – 120%
Sample bracketing	Injection of standard at least every 10 samples
Column	USP Phase G27
Mass range	35 – 600 amu

Abbreviations: S/N = signal-to-noise ratio, RSD = relative standard deviation, amu = atomic mass units

Table 8: Assay performance parameter for headspace sampling gas chromatography with mass detection (HS GC-MS)

Standards	Methanol, Methyl ethyl ketone, Octamethylcyclotetrasiloxane, Isopropyl alcohol
Limit of detection	S/N ≥ 3
Reporting limit	0.1 µg/cm²
Internal standard	Toluene-d_8
Precision	1 ppm Methyl ethyl ketone, RSD = ≤ 20%
Spike recovery	80 – 120%
Sample bracketing	Injection of standard at least every 10 samples
Column	USP Phase G27
Mass range	30 – 300 amu

Abbreviations: S/N = signal-to-noise ratio, RSD = relative standard deviation, amu = atomic mass units

Table 9: Assay performance parameters for inductively coupled plasma with mass detection (ICP-MS)

Standards	Three different multi-element standards
Internal standard	Rhodium, and sample specific others: Lutetium and | or Yttrium
Spike recovery	80 – 120%
Reporting limit	0.1 µg/cm²

6. Results

Table 10: Summary of organic extractables for Sartopore® Platinum basic filter elements

Method	Compound	CAS	ID Level	Concentration Extractables [µg/cm²]		
				30 min	1 d	7 d
Water						
HS GC-MS	Isopropyl alcohol	67-63-0	Confirmed	0.34	12	31
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	0.28	0.73
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	0.67	0.73
$LC\text{-}HRMS_{target}$	Caprolactam	105-60-2	Confirmed	< RL	< RL	0.11
GC-MS	Caprolactam	105-60-2	Confirmed	< RL	< RL	0.18
50% EtOH						
$LC\text{-}HRMS_{target}$	Stearic acid	57-11-4	Confirmed	< RL	0.34	0.65
GC-MS	Lauryl alcohol	112-53-8	Confirmed	< RL	0.27	0.69
GC-MS	Lauryl acrylate	2156-97-0	Confirmed	< RL	0.15	0.41
GC-MS	1,3-Di-*tert*-butylbenzene	1014-60-4	Confirmed	< RL	0.11	0.33
GC-MS	4-Methylbenzaldehyde	104-87-0	Confirmed	< RL	0.36	0.53
GC-MS	Lauryl propionate	6221-93-8	Confident	< RL	0.25	0.71
GC-MS	Caprolactam	105-60-2	Confirmed	< RL	0.28	0.34
$LC\text{-}HRMS_{target}$	Caprolactam	105-60-2	Confirmed	< RL	0.28	0.28
0.1 M H_3PO_4						
HS GC-MS	Isopropyl alcohol	67-63-0	Confirmed	1.2	9.1	7.6
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	0.46	0.45
GC-MS	Caprolactam	105-60-2	Confirmed	< RL	< RL	0.10
$LC\text{-}HRMS_{target}$	Caprolactam	105-60-2	Confirmed	< RL	< RL	0.10
0.5 N NaOH						
HS GC-MS	Isopropyl alcohol	67-63-0	Confirmed	< RL	9.4	9.8
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	0.40	2.9
5 M NaCl						
HS GC-MS	Isopropyl alcohol	67-63-0	Confirmed	0.13	8.2	6.6
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	0.11	0.39
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	0.17	0.18
GC-MS	Caprolactam	105-60-2	Confirmed	< RL	< RL	0.11

Method	Compound	CAS	ID Level	Concentration Extractables [µg/cm²]		
				30 min	1 d	7 d
1% Polysorbate 80						
HS GC-MS	Isopropyl alcohol	67-63-0	Confirmed	1.6	13	11
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	0.37	0.51
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	0.77	0.73
GC-MS	1,3-Di-*tert*-butylbenzene	1014-60-4	Confirmed	< RL	< RL	0.28
GC-MS	Caprolactam	105-60-2	Confirmed	< RL	< RL	0.29
GC-MS	Lauryl acrylate	2156-97-0	Confirmed	< RL	< RL	0.17
GC-MS	Lauryl propionate	6221-93-8	Confident	< RL	0.18	0.41

Table 11: Summary of organic extractables for capsule housing

Method	Compound	CAS	ID Level	Concentration Extractables [µg/cm²]*		
				30 min	1 d	7 d
Water						
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	0.12	0.44
GC-MS	4-Methylbenzaldehyde	104-87-0	Confirmed	< RL	0.13	0.59
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	0.050	0.073
HS GC-MS	Acetone	67-64-1	Confirmed	< RL	0.35	0.44
50% EtOH						
$LC\text{-}HRMS_{target}$	Stearic acid	57-11-4	Confirmed	< RL	0.10	0.25
GC-MS	Lauryl alcohol	112-53-8	Confirmed	< RL	0.15	0.62
GC-MS	Lauryl propionate	6221-93-8	Confirmed	< RL	0.32	0.84
GC-MS	Lauryl acrylate	2156-97-0	Confirmed	< RL	0.17	0.37
GC-MS	2,4-Di-*tert*-butylphenol	96-76-4	Confirmed	< RL	< RL	0.060
GC-MS	1,3-Di-*tert*-butylbenzene	1014-60-4	Confirmed	< RL	0.12	0.36
GC-MS	4-Methylbenzaldehyde	104-87-0	Confirmed	< RL	0.084	0.29
0.1 M H_3PO_4						
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	0.096	0.73	0.50
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	0.30	0.066
GC-MS	4-Methylbenzaldehyde	104-87-0	Confirmed	< RL	0.12	0.55
HS GC-MS	Acetone	67-64-1	Confirmed	0.077	0.50	0.48
0.5 N NaOH						
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	0.098	0.23
GC-MS	4-Methylbenzaldehyde	104-87-0	Confirmed	< RL	0.12	0.47
HS GC-MS	Acetone	67-64-1	Confident	< RL	0.39	0.38
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	0.33	0.050
5 M NaCl						
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	0.07	0.11	0.37
HS GC-MS	Acetone	67-64-1	Confident	0.064	0.40	0.32
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	< RL	0.066

* Reporting limit ≥ 0.04 µg/cm² due to a higher surface area to volume ratio

Method	Compound	CAS	ID Level	Concentration Extractables [µg/cm²]*		
				30 min	1 d	7 d
1% Polysorbate 80						
GC-MS	4-Methylbenzaldehyde	104-87-0	Confirmed	< RL	0.16	0.88
GC-MS	Lauryl alcohol	112-53-8	Confirmed	< RL	< RL	0.83
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	0.077	0.15	0.52
GC-MS	1,3-Di-*tert*-butylbenzene	1014-60-4	Confirmed	< RL	< RL	0.19
GC-MS	Lauryl propionate	6221-93-8	Confirmed	< RL	0.17	0.37
GC-MS	Lauryl acrylate	2156-97-0	Confirmed	< RL	< RL	0.12
GC-MS	2,4-Di-*tert*-butylphenol	96-76-4	Confirmed	< RL	< RL	0.15
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	0.12	0.15

* Reporting limit ≥ 0.04 µg/cm² due to a higher surface area to volume ratio

Table 12: Summary of organic extractables for gamma Midicaps® housing

Method	Compound	CAS	ID Level	Concentration Extractables [µg/cm²]		
				30 min	1 d	7 d
Water						
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	< RL	0.48
50% EtOH						
$LC\text{-}HRMS_{target}$	Stearic acid	57-11-4	Confirmed	< RL	0.41	0.83
$LC\text{-}HRMS_{target}$	2,4-Di-*tert*-butylphenol	96-76-4	Confirmed	< RL	< RL	0.14
$LC\text{-}HRMS_{target}$	Erucamide	112-84-5	Confirmed	< RL	< RL	< RL
GC-MS	Dodecane	112-40-3	Confirmed	< RL	< RL	< RL
GC-MS	1,3-Di-*tert*-butylbenzene	1014-60-4	Confirmed	< RL	< RL	0.32
GC-MS	2,6-Di-*tert*-butyl-1,4-benzoquinone	719-22-2	Confirmed	< RL	< RL	0.19
GC-MS	2,4-Di-*tert*-butylphenol	96-76-4	Confirmed	< RL	< RL	< RL
GC-MS	Stearyl alcohol	112-92-5	Confirmed	< RL	0.11	0.44
GC-MS	Stearyl acrylate	4813-57-4	Confirmed	< RL	< RL	0.12
0.1 M H_3PO_4						
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	< RL	0.63
0.5 N NaOH						
GC-MS	2,4-Di-*tert*-butylphenol	96-76-4	Confirmed	< RL	< RL	< RL
HS GC-MS	Acetone	67-64-1	Confident	0.27	0.33	0.80
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	< RL	0.28
5 M NaCl						
HS GC-MS	Acetone	67-64-1	Confident	0.12	0.33	0.15
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	< RL	0.19
1% Polysorbate 80						
GC-MS	1,3-Di-*tert*-butylbenzene	1014-60-4	Confirmed	< RL	< RL	0.18
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	< RL	0.30

Table 13: Summary of organic extractables for gamma in-line Maxicaps® and T-Style Maxicaps® housing

Method	Compound	CAS	ID Level	Concentration Extractables [µg/cm²]		
				30 min	1 d	7 d
Water						
HS GC-MS	Acetone	67-64-1	Confident	< RL	0.21	0.29
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	< RL	0.24
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	< RL	< RL
50% EtOH						
GC-MS	1,3-Di-*tert*-butylbenzene	1014-60-4	Confirmed	< RL	< RL	0.30
GC-MS	2,6-Di-*tert*-butyl-1,4-benzoquinone	719-22-2	Confirmed	< RL	< RL	0.21
GC-MS	2,4-Di-*tert*-butylphenol	96-76-4	Confirmed	< RL	< RL	0.12
GC-MS	7,9-Di-*tert*-butyl-1-oxaspiro(4,5)-deca-6,9-diene-2,8-dione	82304-66-3	Confirmed	< RL	< RL	< RL
GC-MS	Stearyl alcohol	112-92-5	Confirmed	< RL	< RL	0.12
LC-HRMS$_{target}$	Stearic acid	57-11-4	Confirmed	< RL	0.29	0.67
LC-HRMS$_{target}$	2,4-Di-*tert*-butylphenol	96-76-4	Confirmed	< RL	< RL	0.10
0.1 M H_3PO_4						
HS GC-MS	Acetone	67-64-1	Confident	< RL	0.13	0.47
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	0.13	0.82
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	< RL	0.15
0.5 N NaOH						
HS GC-MS	Acetone	67-64-1	Confident	< RL	< RL	0.82
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	0.11	0.46
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	< RL	0.12
5 M NaCl						
HS GC-MS	Acetone	67-64-1	Confident	< RL	0.14	0.22
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	0.12	0.24
HS GC-MS	Methyl ethyl ketone	78-93-3	Confirmed	< RL	< RL	< RL
1% Polysorbate 80						
GC-MS	1,3-Di-*tert*-butylbenzene	1014-60-4	Confirmed	< RL	< RL	0.17
GC-MS	2,4-Di-*tert*-butylphenol	96-76-4	Confirmed	< RL	< RL	0.16
GC-MS	7,9-Di-*tert*-butyl-1-oxaspiro(4,5)-deca-6,9-diene-2,8-dione	82304-66-3	Confirmed	< RL	< RL	< RL
HS GC-MS	Acetone	67-64-1	Confident	< RL	< RL	0.80
HS GC-MS	*Tert*-Butanol	75-65-0	Confirmed	< RL	0.14	0.33
HS GC-MS	2,2,4,6,6-Pentamethylheptane	13475-82-6	Confirmed	< RL	< RL	0.12

Table 14: Summary of elemental impurities according to ICH Q3D, USP <232> including tungsten and silicon after seven days [ng/cm²] for Sartopore® Platinum basic filter elements

Element	Element Classification	50% EtOH	1% Polysorbate 80	5 M NaCl	0.5 N NaOH	0.1 M H_3PO_4	Water
Cd	Class 1	–	–	–	–	–	–
Pb	Class 1	–	–	–	–	–	–
As	Class 1	–	–	–	–	–	–
Hg	Class 1	–	–	–	–	–	–
Co	Class 2A	–	–	–	–	–	–
V	Class 2A	–	–	–	–	–	–
Ni	Class 2A	–	–	–	–	–	–
Tl	Class 2B	–	–	–	–	–	–
Au	Class 2B	–	–	–	–	–	–
Pd	Class 2B	–	–	–	–	–	–
Ir	Class 2B	–	–	–	–	–	–
Os	Class 2B	–	–	–	–	–	–
Rh	Class 2B	–	–	–	–	–	–
Ru	Class 2B	–	–	–	–	–	–
Se	Class 2B	–	–	–	–	–	–
Ag	Class 2B	–	–	–	–	–	–
Pt	Class 2B	–	–	–	–	–	–
Li	Class 3	–	–	–	–	–	–
Sb	Class 3	–	–	–	110	–	–
Ba	Class 3	–	–	–	–	–	–
Mo	Class 3	–	–	–	–	–	–
Cu	Class 3	–	–	–	–	–	–
Sn	Class 3	–	–	–	–	–	–
Cr	Class 3	–	–	–	–	–	–
Si		–	–	–	–	–	–
W		–	–	–	–	–	–

Table 15: Summary of elemental impurities according to ICH Q3D, USP <232> including tungsten and silicon after seven days [ng/cm²] for capsule housing *

Element	Element Classification	50% EtOH	1% Polysorbate 80	5 M NaCl	0.5 N NaOH	0.1 M H_3PO_4	Water
Cd	Class 1	–	–	–	–	–	–
Pb	Class 1	–	–	–	–	–	–
As	Class 1	–	–	–	–	–	–
Hg	Class 1	–	–	–	–	–	–
Co	Class 2A	–	–	–	–	–	–
V	Class 2A	–	–	–	–	–	–
Ni	Class 2A	–	–	–	–	–	–
Tl	Class 2B	–	–	–	–	–	–
Au	Class 2B	–	–	–	–	–	–
Pd	Class 2B	–	–	–	–	–	–
Ir	Class 2B	–	–	–	–	–	–
Os	Class 2B	–	–	–	–	–	–
Rh	Class 2B	–	–	–	–	–	–
Ru	Class 2B	–	–	–	–	–	–
Se	Class 2B	–	–	–	–	–	–
Ag	Class 2B	–	–	–	–	–	–
Pt	Class 2B	–	–	–	–	–	–
Li	Class 3	–	–	–	–	–	–
Sb	Class 3	–	–	–	–	–	–
Ba	Class 3	–	–	–	–	–	–
Mo	Class 3	–	–	–	–	–	–
Cu	Class 3	–	–	–	–	–	–
Sn	Class 3	–	–	–	–	–	–
Cr	Class 3	–	–	–	–	–	–
Si		–	–	–	–	–	–
W		–	–	–	–	–	–

* Reporting limit ≥ 0.04 µg/cm² due to a higher surface area to volume ratio

Table 16: Summary of elemental impurities according to ICH Q3D, USP <232> including tungsten and silicon after seven days [ng/cm²] for gamma Midicaps® housing

Element	Element Classification	50% EtOH	1% Polysorbate 80	5 M NaCl	0.5 N NaOH	0.1 M H_3PO_4	Water
Cd	Class 1	–	–	–	–	–	–
Pb	Class 1	–	–	–	–	–	–
As	Class 1	–	–	–	–	–	–
Hg	Class 1	–	–	–	–	–	–
Co	Class 2A	–	–	–	–	–	–
V	Class 2A	–	–	–	–	–	–
Ni	Class 2A	–	–	–	–	–	–
Tl	Class 2B	–	–	–	–	–	–
Au	Class 2B	–	–	–	–	–	–
Pd	Class 2B	–	–	–	–	–	–
Ir	Class 2B	–	–	–	–	–	–
Os	Class 2B	–	–	–	–	–	–
Rh	Class 2B	–	–	–	–	–	–
Ru	Class 2B	–	–	–	–	–	–
Se	Class 2B	–	–	–	–	–	–
Ag	Class 2B	–	–	–	–	–	–
Pt	Class 2B	–	–	–	–	–	–
Li	Class 3	–	–	–	–	–	–
Sb	Class 3	–	–	–	–	–	–
Ba	Class 3	–	–	–	–	–	–
Mo	Class 3	–	–	–	–	–	–
Cu	Class 3	–	–	–	–	–	–
Sn	Class 3	–	–	–	–	–	–
Cr	Class 3	–	–	–	–	–	–
Si		340	–	430	–	140	110
W		–	–	–	–	–	–

Table 17: Summary of elemental impurities according to ICH Q3D, USP <232> including tungsten and silicon after seven days [ng/cm²] for gamma in-line Maxicaps® and T-Style Maxicaps® housing

Element	Element Classification	50% EtOH	1% Polysorbate 80	5 M NaCl	0.5 N NaOH	0.1 M H_3PO_4	Water
Cd	Class 1	–	–	–	–	–	–
Pb	Class 1	–	–	–	–	–	–
As	Class 1	–	–	–	–	–	–
Hg	Class 1	–	–	–	–	–	–
Co	Class 2A	–	–	–	–	–	–
V	Class 2A	–	–	–	–	–	–
Ni	Class 2A	–	–	–	–	–	–
Tl	Class 2B	–	–	–	–	–	–
Au	Class 2B	–	–	–	–	–	–
Pd	Class 2B	–	–	–	–	–	–
Ir	Class 2B	–	–	–	–	–	–
Os	Class 2B	–	–	–	–	–	–
Rh	Class 2B	–	–	–	–	–	–
Ru	Class 2B	–	–	–	–	–	–
Se	Class 2B	–	–	–	–	–	–
Ag	Class 2B	–	–	–	–	–	–
Pt	Class 2B	–	–	–	–	–	–
Li	Class 3	–	–	–	–	–	–
Sb	Class 3	–	–	–	–	–	–
Ba	Class 3	–	–	–	–	–	–
Mo	Class 3	–	–	–	–	–	–
Cu	Class 3	–	–	–	–	–	–
Sn	Class 3	–	–	–	–	–	–
Cr	Class 3	–	–	–	–	–	–
Si		520	–	–	–	–	–
W		–	–	–	–	–	–

7. Summary

In order to calculate the total amount of a selected extractable for a specific filter element, the respective input of the basic filter element (Table 10) and the corresponding Filter Housing (Table 11, Table 12 or Table 13) have to be taken into account.

The extraction of the components took place under exaggerated worst-case conditions for most biomanufacturing applications regarding temperature, time, extraction medium and pH. Normal process conditions are less aggressive with regard to extractions conditions and therefore fewer extractables will occur compared to the data shown in this report.

Additional information of the Sartorius Stedim gamma Sartopore® Platinum products can be found in the Validation Guide as well as in the Extractables Guide.

8. Document History

Version Number	Description of Change	Version Date
00	Initial release of the BPOG report for Sartopore® Platinum product family. Data generated according to BPOG proposal version 2014	June 2018
01	Update to new Sartorius brand design. Minor text corrections, application of reporting limits, introduction of document history	June 2021

Germany
Sartorius Stedim Biotech GmbH
August-Spindler-Strasse 11
37079 Goettingen
Phone +49 551 308 0

USA
Sartorius Stedim North America Inc.
565 Johnson Avenue
Bohemia, NY 11716
Toll-Free +1 800 368 7178

For further information, visit
www.sartorius.com

DIR No.: 2396281-000-01 | Status: 10 | 12 | 2021