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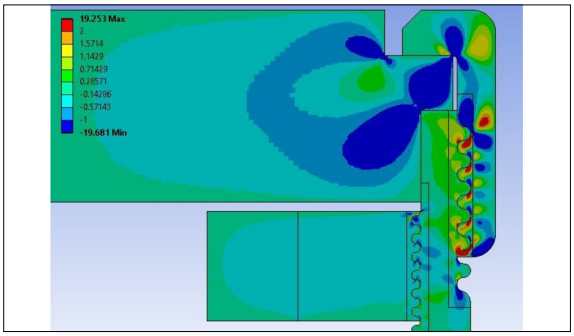
Subject Area	Plastics Technology
Project Partner	Maxwell Technologies SA, Rossens, FR

Capacitor with pre-casted parts

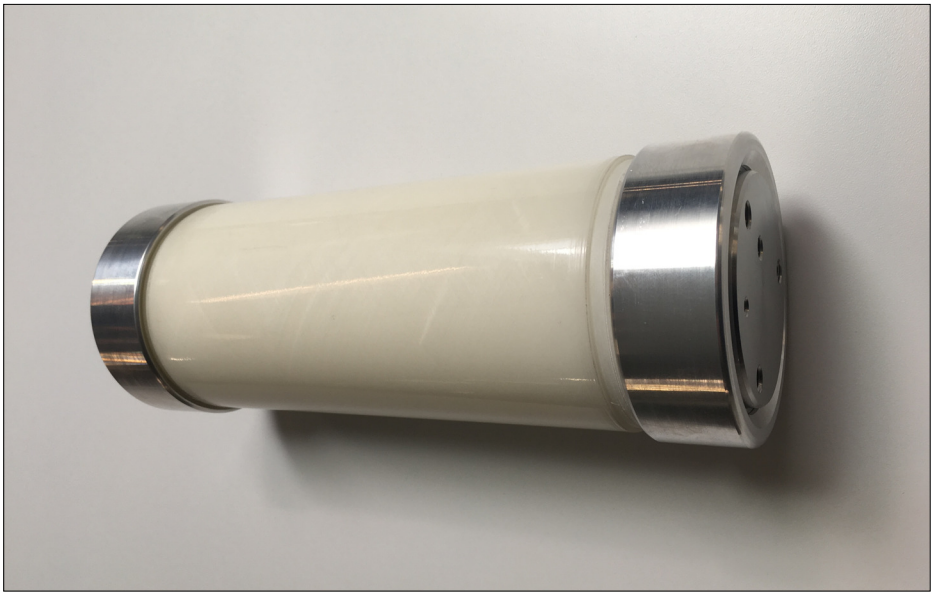
Notation	Tensile strenght [MPa]	E-Modulus [MPa]	Creep modulus [MPa]	Permittivity 50 Hz [-]	Dissipation coefficient 50 Hz [10⁻⁴]	Breakdown voltage [kV/mm]	Expansion coefficient [10⁻⁶/K]	Thermal endurance limit MAX [°C]	Thermal endurance limit MIN [°C]	Density [g/cm³]	Price group
POM-C E ①	63	2600	1300	3.8	10	40	120	100	-50	1.39	1
POM-C ①	65	2700	1400	3.8	10	40	110	100	-50	1.39	1
POM-C USP ②	63	2600	1300	3.8	10	40	120	100	-50	1.39	2
POM GF25 ②	135	9200	5400	4.3	30	40	50	100 5)	-50	1.6	2
PE-UHMW ③	17	720	230	2.1	3.9	45	200	80	-200	0.93	2
PE-HMW ①	26	1100	250	2.8	2	50	145	80	-80	0.95	1
PE-HD ①	30	1350	400	2.4	2	53	135	90 4)	-80	0.963	1
RPO ②	55	2300	-	2.7	20	57	70	105 5)	-50	1.06	2
PES GF20 ②	130	7500	5600	4.2	20	42	46	190 5)	-100	1.53	4
PMP (TPX)	25	1400	-	2.1	0.7	50	12	135	-	0.83	4
PSU -GF20	115	6800	-	3.5	30	46	100	180 4)	-	1.38	4

①-⑤: Price group (from cheap to expensive),
4) Thermal aging, reduction of tensile strenght per 50 % after 20000 h
5) Thermal aging, UL 746 (RTI) Mechanical W/O Imp., 40000 h

Construction material research



FE-simulation with ANSYS Workbench



Prototype of proposal concept

Objective: MAXWELL Technologies is a global leader in high voltage technology. In 2017 a CTI project was launched together with the IWK to develop a dry capacitor for high voltage applications. The HSR proposed to use polymer materials that do not absorb dielectric oil. The aim of the project is to define concept proposals with pre-casted and pre-formed parts for the windings framework in order to reduce costs, decrease the dielectric fluid volume and to increase the ease of use. The selected concept has to be built as prototype and the costs have to be calculated for a serial manufacturing.

Procedure / Result: The project has been processed respecting the workflow guideline for product development. Critical aspects and problems for the future material research and design are identified during the project stage "Clarify". During the project stage "conception/design", different concepts have been developed and evaluated. The selected concept has been elaborated in the project stage "dimensioning" using analytical and FE-simulation to proof the structural and functional safety of the conceived capacitor. In the last project stage "finalize", detailed aspects have been investigated, such as the definition of a related assembling process, the cost calculation and the manufacturing process of the prototype.

Result: The main result is a concept proposal for a capacitor with pre-formed parts where the related material and manufacturing costs are defined. Additionally the structure of the thread in the insulator has been optimized using FE-simulation, to improve the structural behaviour of the capacitor. A standardized O-ring solution has been implemented, to guarantee tightness and reproducibility during the assemby of the system-sealing. The electrical contact from the capacitive windings was simplified in order to speed up the assembling process. Additionally, an alternative solution has been proposed for the expansion-bellow to improve the impregnation process.