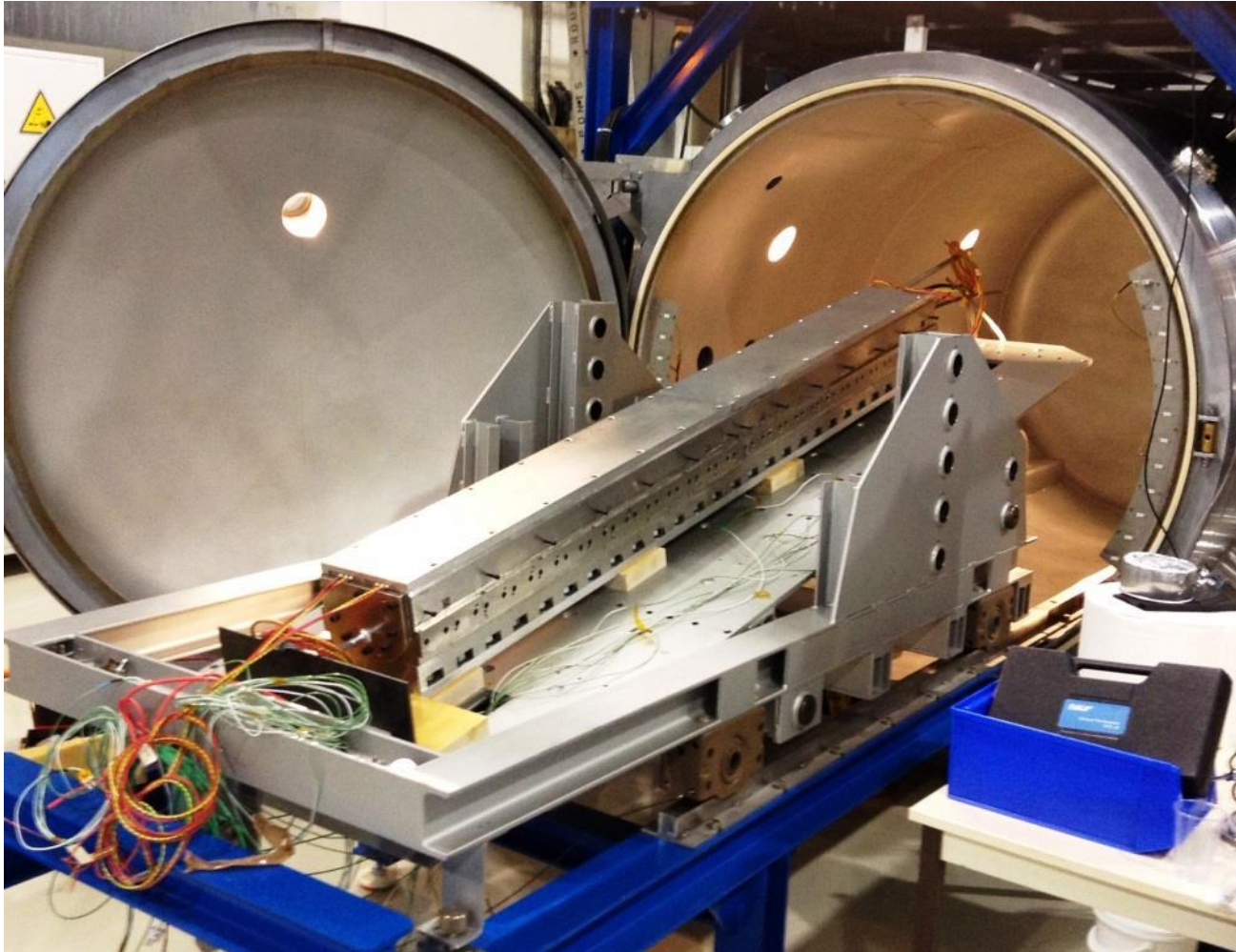


Modification of the 11T Dipole impregnation mould

Impact on impregnation parameters

Remy Gauthier, 19.05.2015

Impregnation procedure 11 Tesla coils



Impregnation procedure 11 Tesla coils

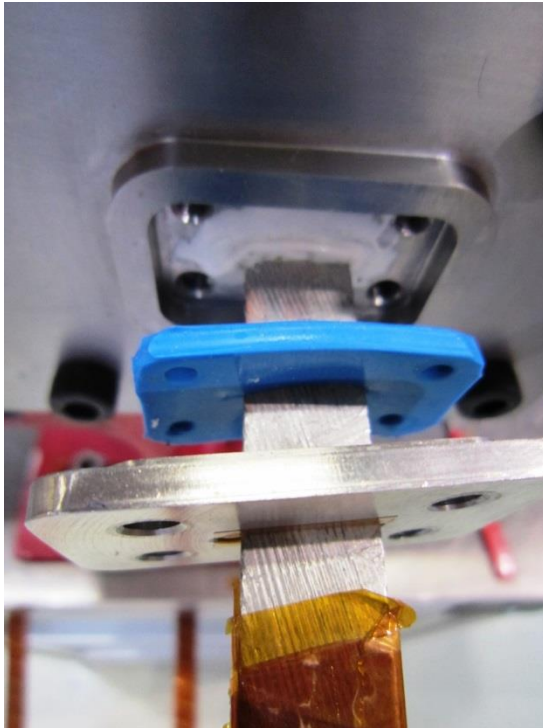
- Mold preparation
- Resin CTD 101K
- Mold installation in the Telstar impregnation system.
- Mold preparation before closing the tank
- Impregnation
- Curing

Comparison impregnation parameters

Impregnation	Mould tightness test	Bakeout (outgassing)			Agitated Degas		
	Time to recover atm press	Temp. mould	Time	Press. chamber	Temp. reservoir	Time	Press. reservoir
	[s]	[°C]	[h]	[mbar]	[°C]	[h]	[mbar]
#109 tool	~40	60	min 48	~10 ⁻³	55-60	1	~7.5x10 ⁻²
#110-111 tool	<10	60	min 48	~10 ⁻³	55-60	1	~7.5x10 ⁻²

Impregnation	VPI						
	Feed Method	Temp	Resin across mould	Total Time	Press. chamber	Press. mould	Press. reservoir
		[°C]	[h]	[min]	[mbar]	[mbar]	[mbar]
#109 tool	ΔP	60	~3	~7	~10 ⁻³	~8.9x10 ⁻¹	atm press
#110-111 tool	ΔP	60	~1	~2.5	~10 ⁻³	~1.7x10 ⁻¹	600

Impregnation procedure 11 Tesla coils



We prepare the 11 Tesla coils into is impregnation mould and we make all the connection tight. We make the vacuum into the mould and monitor it. The vacuum lost after 15 minutes should be under 300mbar to avoid lick of resin.

Impregnation procedure 11 Tesla coils

Resin CTD 101K

It is anhydride cured epoxy system with excellent performance at cryogenic temperature and excellent radiation resistance. It is formulated with very long pot life.

The mold is impregnated at 60 C

Temperature C	Pot Life H	Viscosity mPa/s
25	145	1300
40	60	400
60	20	100

Curing T – cycle

Cure 5Hrs @ 110 C.

Post cure 16 Hrs. @ 125 C

Impregnation procedure 11 Tesla coils



The mold is placed on the tray of the Telstar machine over thermal isolated support. The tray is lifted up 12 degrees to give a slope to the mold. The mold is purged with nitrogen during 3 hours.



Impregnation procedure 11 Tesla coils

The mold is placed into the tank, there are 4 couples of heating cartridges controlled by 4 sensors of temperature. We added a filter just before the injection point of the mold to avoid problems in case there is particle drain by the resin.



We place a Pirani sensor on the channel of injection tube to measure the vacuum level into the mold before the injection of the resin. We observed a difference of factor 10 or 100 on the vacuum level of the mold and the chamber. (chamber $1 \cdot 10^{-3}$ mbar mold $1 \cdot 10^{-1}$ mbar).



Impregnation procedure 11 Tesla coils

The mixture of resin is heated at 60 C under agitation and degas into the mixing tank . We degas the resin until we obtain a vacuum level 8.5×10^{-2} mbar that level of vacuum is achieved only if we stopped the agitator into the mixing tank. We stop the vacuum pump and increase the pressure into the mixing tank at 500mbar to allow the resin to flow through the flowmeter. At the end of the impregnation we increase the pressure to 1 bar into the mixing tank to force the resin into the mold that could help the resin going in some void if there is some. We break the vacuum cut the injection tube and restart the vacuum during 4 hours to allow some time to the resin to impregnate every void.



Impregnation procedure 11 Tesla coils

At the end of the impregnation we break the vacuum and start the cycle of polymerization for the resin. The temperature increase from 60C to 110C we added a stage at 90C during one hour to avoid the over shoot of the mold in a reason there is some delay between the heating cartridges power and the information from the sensor. The polymerization cycle is 6 hours at 110C and 16 hours at 125C has recommended by CTD company. At the end when the power is cut off we live the mold into the tank until it reached a temperature around 50C before taking it out of the tank.

