

1 Qualitative assessment of demoulding

1.1 Industrial mould

The SME BARBIERI has performed the qualitative assessment of demoulding of a production mould of its property, without and with a PVD coating, which was applied by the SME DMX. The production mould used for this exercise is shown in **Figure 1**.



Figure 1. Production mould for demoulding assessment property of BARBIERI – Mould GBS5852-300-500-96A

Initially, the mould selected by BARBIERI was severely damaged by an intensive service and it seemed that the substrate had been attacked by acids at some point of its life. DMX stripped the mould, prepared the surfaces by micro blasting with very fine media (F500), process that was not able to repair the smallest damaged portions and degas the cavities before proceeding with the PVD coating. **Figure 2** shows the result of this reparation process on the surfaces of the mould.



Figure 2. Detail of the repaired surface of the mould by DMX

The coating, also selected by DMX was DM309XS, which is actually one of the prototype layers being under research at the company. It is not the layer with the optimal lifetime, but it shows the best adhesion properties. This layer will evolve in the future, but its development is sufficiently advanced to ensure promising results.

BARBIERI injected 100.000 parts with the uncoated mould and 100.000 parts with the PVD coated mould, with three different materials: NBR, EPDM and CR (polychloroprene rubber).

Three variables related to demoulding were qualitatively assessed after the complete series of 100.000 injected parts with the uncoated mould and after series of 20.000 injected parts with the coated mould, at three levels for each variable:

- How long does the demoulding of the part take?– **“Demould behaviour”**
 - Hard – the demoulding takes more than 40s
 - Medium – the demoulding of the part takes between 30 and 40s
 - Low – the demoulding of the part takes less than 30s
- How clean is the tool after demoulding the part – **“tool clean”**. This variable is measured in terms of the length of the dirtiness spots on the mould surface after demoulding.
 - Hard dirty – after the demoulding, the spots are more than 1.5 mm length and there are a lot of them.
 - Medium dirty - after the demoulding, the spots are more than 1.0 mm length and there are some of them.
 - A little dirty - after the demoulding, the spots are less than 0.5 mm length and there are few of them
 - Clean - after the demoulding, there are not spots.
- How long is the injection time of the part – **“injection time”**
 - High – the injection time takes more than 40s.
 - Medium – the injection time takes between 35 and 40s.
 - Low – the injection time takes less than 35s.

Results reported by BARBIERI are included in Table 1.



		PRODUCT					
		Code: SL30050069		Start Data: 26/05/2015			
		Material: NBR - EPDM - CR		Stop Data: 26/06/2015			
		Customer: TDM SEALS Research					
N°	Feature	Uncoated value after 100.000 Pcs	Coated Value found				
			Pcs 1-20K	20K-40K	40K-60K	60K-80K	80K-100K
1	Material: NBR De-mould behavior	hard	medium	medium	medium	medium	medium
2	Material: EPDM De-mould behavior	hard	medium	medium	medium	medium	medium
3	Material: CR De-mould behavior	hard	medium	medium	medium	medium	medium
4	Material: NBR tool clean	hard dirty	clean	clean	a little dirty	a little dirty	a little dirty
5	Material: EPDM tool clean	hard dirty	clean	clean	clean	a little dirty	a little dirty
6	Material: CR tool clean	very hard dirty	clean	a little dirty	a little dirty	medium dirty	medium dirty
7	Material: NBR injection time	medium	low	low	low	low	low
8	Material: EPDM injection time	medium	low	low	low	low	low
9	Material: NBR injection time	medium	low	low	low	low	low

Table 1. Results for qualitative assessment of demoulding with a production mould.

From the obtained results it can be observed that:

- The DM309XS coating reduces the difficulty of demoulding from hard to medium for all the series of injected parts with the three materials and keeps its effectiveness along all the series.
- In general, the DM309XS coating reduces the dirtiness of the mould after demoulding for the three materials. The ranking of effectiveness of the coating for the three materials is: 1st) for EPDM, 2nd) for NBR and 3rd) for CR. As long as the number of injected parts increases, the effectiveness of the coating in terms of prevention of dirtiness decreases.
- The DM309XS coating allows reducing the injection time in 20% for the three materials, equivalent to 2% of the total production time.