

System		carbofill®	RSS® Flüssigboden	TerraFlow®	Terrapact®	WBM- und Betonwaren®
Manufacturer		Thomas Zement GmbH & Co KG	FiFB GmbH	Heidelberger Beton GmbH	Holcim Beton und Betonwaren GmbH	WBM-Flüssigboden GmbH
<b>IKT - Test report*</b>		<b>GOOD 1.9</b>	<b>GOOD 1.9</b>	<b>SATISFACTORY 3.4</b>	<b>INADEQUATE 6.0</b>	<b>INADEQUATE 6.0</b>
The following weighting applies to four 'knock-out' (K.O.) criteria (see box below): - 1x deficient: overall mark devaluation by 1.0 - 1x Inadequate: overall mark = 6.0 <sup>2</sup>		-	-	Re-excavation capability POOR	Re excavation capacity <b>INADEQUATE</b> Not for use in sewer construction.	Superstructability POOR, Recycling POOR and occupational safety risk Not for use in sewer construction.
<b>System performance</b>	<b>85%</b>	<b>1.9</b>	<b>1.9</b>	<b>2.4</b>	<b>Not rateable<sup>6</sup></b>	<b>2.8</b>
<b>Installation phase</b>	<b>40%</b>	<b>2.1</b>	<b>2.4</b>	<b>1.8</b>	<b>Not rateable<sup>6</sup></b>	<b>2.6</b>
Flowability (K.O. criterion <sup>3</sup> )	30%	2.0	2.0	2.0	3.0	3.0
Pipe bedding	20%	1.0	3.0	2.0	Not rateable <sup>6</sup>	1.0
Removal of shoring	20%	1.0	4.0 <sup>5</sup>	1.0	4.0 <sup>5</sup>	1.0
Volume stability	10%	1.0	2.0	2.0	2.0	1.0
Accessibility	20%	5.0	1.0	2.0	2.0	6.0
<b>Use phase</b>	<b>30%</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>Not rateable<sup>6</sup></b>	<b>4.0</b>
Buildability (K.O. criterion <sup>3</sup> )	40%	1.0	1.0	1.0	1.0	5.0 <sup>c</sup>
Risk of subsidence	25%	1.0	1.0	1.0	1.0	6.0
Bedding properties	30%	1.0	1.0	1.0	Not rateable <sup>6</sup>	1.0
Root protection	5%	3.0	3.0	3.0	3.0	3.0
<b>Disposal phase</b>	<b>30%</b>	<b>2.3</b>	<b>2.0</b>	<b>4.5</b>	<b>5.4</b>	<b>1.8</b>
Re-excavation capacity (K.O. criterion <sup>3</sup> )	80%	2.1	1.7	4.8 <sup>a</sup>	6.0 <sup>b</sup>	1.0
Recycling (K.O. criterion <sup>3</sup> )	20%	3.0	3.0	3.0	3.0	5.0 <sup>c</sup>
<b>Quality assurance<sup>4</sup></b>	<b>15%</b>	<b>2.0</b>	<b>2.0</b>	<b>2.5</b>	<b>2.5</b>	<b>4.5</b>
Delivery note complete and correct	20%	+	+	0	0	0
Self-monitoring	20%	+	+	+	+	-
Quality mark	20%	+	+	+	+	+
Training	20%	-	+	+	-	-
Particular conspicuous features (K.O. criterion)	20%	None (+)	Exclusion of warranty (addition of water) (-)	Too little material delivered (-)	None (+)	Occupational safety risk Ammonia (MAK value exceeded). material lumps. increased cyanide content (-)
<b>Additional information (not part of the grading)</b>						
pH value material (at installation)		12.7	13.2	12.6	12.8	12.9
Viscosity balance (average shear strength 1st / 2nd day)		0.281 kPa/ 0.242 kPa	0.302 kPa/ 0.334 kPa	0.290 kPa/ 0.340 kPa	0.303 kPa/ 0.300 kPa	0.264 kPa/ 0.322 kPa
Time required for installation		15 min per mixer	15 min per mixer	15 min per mixer	15 min per mixer	15 min per mixer
Mixing plant		Ready-mix concrete Ennepe Ruhr	Phoenix Beton GmbH Gelsenkirchen	Heidelberger Beton Werk RE	Holcim Beton und Betonwaren GmbH Herne	Klöstere Essen GmbH
Distance of the mixing plant from IKT		50 min / 33 km	35 min / 5 km	55 min / 22 km	40 min / 14 km	55 min / 18 km
Number of deliveries (total 50m <sup>3</sup> )		8	8	8	7	6
Material costs [EUR/m <sup>3</sup> ]		186	139	68	89	104
Pumping costs [EUR/m <sup>3</sup> ]		30	99	16	21	30
Testing costs (self-monitoring) [EUR]		0	3384	0	0	1.505
Waste disposal costs [EUR/t]		35	35	35	35	85

### Devaluation due to knockout (K.O.) criteria

**a TerraFlow®:** grade 5.0 in the three sub-categories of the knock-out criterion "re-excavation capability": compressive strength after 28 days, post-curing, 50-year prognosis

**b Terrapact®:** Not to be used as liquid soil (ZFSV) in sewer construction due to grade 6.0 in all sub-categories of the knock-out criterion "re-excavation capability": solubility, compressive strength after 28 days, post-curing, 50-year prognosis

**c WBM-Flüssigboden®:** grade 5.0 in the knock-out criterion "biodegradability" due to biodegradability after more than 28 days (instead of the required 28 days), grade 5.0 in the knock-out criterion "recycling" due to allocation of the material to landfill class 1 (DK 1)

- 1 ZFSV = temporarily flowable self-compacting backfill material
- 2 6.0 Evaluation decided after discussion in the steering committee.
- 3 K.O. criterion: At grade 6.0 not applicable as liquid soil (ZFSV) in sewer construction
- 4 Rating: "+" = proven, "o" = partially proven, "-" = not proven
- 5 Massive surface collapse recognisable
- 6 Inspection of the pipeline enclosure could not be carried out due to insufficient ability to re-excavate

\*Evaluation key of the test results: Very good = 1.0 - 1.5. good = 1.6 - 2.5. satisfactory = 2.6 - 3.5. sufficient = 3.6 - 4.5. Poor = 4.6 - 5.5. Inadequate = 5.6 - 6.0.

\* Calculation of marks and ranking based on unrounded values