Empowering Infrastructure
FOUNDATION & SUBSTRUCTURE

TERRA-MIX® IMPULSE COMPACTION

The economic alternative for ground improvement

We compact the ground down to a depth of 7m*!

* ... depending on the ground conditions down to 9 m
**Terra-Mix® Impulse Compaction**

**Impulse Compaction**
The TERRA-MIX system is an innovative method for ground improvement down to medium depths. With this system all compactable grounds can be quickly and economically compacted.

In combination with a replacement base layer or stone columns even cohesive soil can be turned into good bearing soil.

**Optimal Alternatives**
To conventional methods of soil improvement such as: vibration/stuffing/pressure method, soil replacement, drilling poles, ductile poles, jet grouting, DYNIV...

**Areas of Application**
Impulse compaction can for instance be used in the following areas:
- **Above ground construction**: shopping centres, hall constructions, logistics- and storage centres, container-storage areas, dwelling houses
- **Infrastructure**: roads, motorways, railroads, bridges, sub-construction for taxiways...
- **Water and foundation engineering**: high water protection dams, retention basin

**Distance to Constructions**
For adjacent buildings, roads and dams this work can be carried out without hesitation. If needed shock measurements are done directly at the constructions.

**Time Savings**
With thorough preparations the construction activity using impulse compaction can usually be accomplished quicker than with other foundation building alternatives, since this system is very efficient.

**Building Cost Savings**
Due to the high quality of the compaction savings can be made in the statics or in the dimensioning of the foundations. Hence the total building cost for the construction will be reduced.
**TERRA-MIX® IMPULSE COMPACTION**

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**QUALITY ASSURANCE**
Every project has complete documentation of all relevant data for all compaction points:
- GPS-co-ordinates, date, time, applied energy, number of impulses, settling per impulse.
- Based on these data the compaction result can be reproduced during as well as after the work process.

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**LEADING COMPANY IN EUROPA**
As a result of our long lasting experience as well as our intensive research and development work we have become the market leader in the area of impulse compaction.

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**GENTLE ON RESOURCES**
Usually the soil material at hand can be processed. Extraneous material is mostly only needed to a lesser extent. Thereby the building site produces a favourable ecological footprint (CO₂-balance).
**THE IMPULSE COMPACTION**

The principle of impulse compaction consists of dropping a weight of 950 with a high blow frequency (40-60 blows/min) from a defined height repeatedly onto a steel plate, the so-called “Compactor foot”. The plate remains in constant contact with the to be compacted ground, thus ensuring an efficient energy transfer. In this way the sub-soil is locally compacted by every impact. The thus formed crater is filled in with suitable material and in turn compacted by the impulse compactor. In this manner an additional homogenisation of the sub-soil takes place.

**TECHNICAL DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total weight</td>
<td>950 kg</td>
</tr>
<tr>
<td>Weight of the hammer</td>
<td>900 kg</td>
</tr>
<tr>
<td>Drop height</td>
<td>max. 1.2 m</td>
</tr>
<tr>
<td>Weight of foot</td>
<td>400 kg</td>
</tr>
<tr>
<td>Diameter of the foot</td>
<td>0.8; 1.5 or 2.0 m</td>
</tr>
<tr>
<td>Number of blows</td>
<td>40-60/min</td>
</tr>
</tbody>
</table>

**Components:**
- Compactor cap
- Compactor foot
- Hydraulic hammer
- On-board computer incl. GPS-system
- 50 to cantilever
**Terra-Mix® Impulse Compaction**

**THE IMPULSE COMPACTOR**

- Cantilever
- Compactor foot
- Compactor cap
- Hydraulic hammer
- On-board computer incl. GPS-system

The compactor foot leads to a steel plate with a diameter of 1.5m. Depending on the application, steel plates of 0.8 or 2.0m can be deployed. The impulses are transmitted vertically from the hydraulic hammer via the foot to the ground. As undercarriage serves a chain excavator with the appropriate equipment.

**DOT MATRIX**

The ground improvement follows an exact defined plan. Each individual compaction point is shown on a distribution plan and this is subsequently transferred into the on-board computer.

**Examples**

- 2 x 2
- 2.5 x 2.5 + finish
- 3 x 3 + finish
NUMBER OF TRANSITIONS

The point distances in the grid as well as the number of transitions are individually adapted for every project.

After having completed the calibration field and having evaluated the probes the parameters are readjusted.

The modern software enables a work accompanying control of performance and quality.
TERRA-MIX® IMPULSE COMPACTION

EFFICIENCY COMPARISON OF DIFFERENT DYNAMIC GROUND IMPROVEMENT METHODS

* (depending on ground conditions)
TERRA-MIX® IMPULSE COMPACTION

MODE OF OPERATION

_DEPTH EFFECT

This depends on the type of soil and its layer composition. Under consideration of the soil properties, an individual compaction program is determined. With favourable prerequisites it is possible to reach compaction depths of 3m.

\[ T = \sqrt{\text{hammer weight} \times \text{drop height}} \times \text{factor A} + 0.8 \text{ m}^2 \]

\[ T = \sqrt{\text{factor A} \times \text{drop height}} \times \text{hammer weight} + 0.8 \text{ m}^2 \]

<table>
<thead>
<tr>
<th>Type of soil</th>
<th>Factor A</th>
<th>Depth Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grit</td>
<td>Up to 2.5</td>
<td>7 to 9 m</td>
</tr>
<tr>
<td>Sand</td>
<td>Up to 2.7</td>
<td>Also more than 9 m</td>
</tr>
<tr>
<td>Fine grained</td>
<td>1.0</td>
<td>6.1 m</td>
</tr>
<tr>
<td>Fine grained grit</td>
<td>1.5</td>
<td>5.7 m</td>
</tr>
</tbody>
</table>

- Grit
- Grit with mud
- Clayey grit
- Sand
- Fine grained sand
- Clayey sand
- Mining refuse (coarse, sinister, ash)
- Other refuse
- Mud
- Clay
_A RATIONAL METHOD_

The TERRA-MIX impulse compaction method allows a safe, economic and quick method of ground improvement.

**Energy = m x g x h**

- **Power max.**
  - 6.4 MNm/min
  - **E = 9000 kg x 9.81 m/s² x 1.2 m = 105,948 Nm**
  - Blows: 40 - 60/min
  - Power: 4.2 - 6.4 MNm/min

- **Power max.**
  - 4.4 MNm/min
  - **E = 10,000 kg x 9.81 m/s² x 5 m = 490,500 Nm**
  - Blows: 1 - 2/min
  - Power: 0.5 - 4.4 MNm/min
**TERRA-MIX® IMPULSE COMPACTION**

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**COMPACATION CONTROL**

The achieved compaction can most efficiently be verified by dynamic probing or with CPT (Cone Penetration Test) before and after the compaction. Continuous recording, storing and documentation of all relevant compaction parameters for every compaction point ensure the quality.

The following data are recorded for every compaction point: Date, exact locations by means of GPS, settling per impact as well as total settling, settling curve, number of impulses and applied energy.

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**DOCUMENTATION**

All above mentioned data can be provided daily via mobile internet as a table or graphically onto the CAD-plan.

We are the only company worldwide having a completely automatic data recording system for impulse compaction!
**Terra-Mix® Substructure Improvement**

Combination of Impulse Compaction + Ground Stabilization

- Foundation of a Construction
- Load distribution by means of a layer with (high) inherent strength
  - Arching effect between the points of compaction

- Creating a shallow foundation is possible
  (single, stripe foundations, base plates)
- Uniform bedding conditions
- Uniform settlements, low settlement differences
Terra-Mix® Substructure Improvement Depth Effect

Static Roller
- 0.2 m
- 0.5 m

Dynamic Roller
- 0.4 m
- 1.0 m

Impulse Compaction
- 4.5 m

DYINV
- 7.0 m

(with favourable ground conditions down to 9.0 m or even deeper!)

Normal depth effect
- 10 m

Max. possible depth effect
- 14 m
TERRA-MIX® SUBSTRUCTURE IMPROVEMENT
IMPULSE COMPACTOR SPECIFICATION

**Technical data**
- Drop weight: 9to
- Drop height: max. 1,2 m
- Plate diameter: 1,5 m
- Impact frequency: 40 blows/min
- Effective depth: 4,5 – 9,0* m

Drop weight (9t)
Cantilever equipment (45t); Total weight (65t)
Compactor cap
Compactor plate („Foot“) Ø 1,5 m
**TERRA-Mix® Substructure Improvement**

**Compaction Workflow**

1. Pass
2. Pass
- Filling in and roller compaction
3. Pass („Finishing“)
- Filling in and roller compaction

Reconstruction of Railway station Stadlau (2008)

19.08.2008
Terra-Mix® Substructure Improvement