

Introduction

HydroStor chamber systems require a specific backfill in order to provide the chambers with necessary support to handle both live and dead loading. This document will outline the backfill specified for use with HydroStor products and review several acceptable and unacceptable backfill materials.

Refer to Prinsco's *HydroStor HS31-HS75 Installation Guide* and *HydroStor HS180-HS290 Installation Guide* for acceptable fill material in the initial and final backfill areas and for further guidance on proper installation of HydroStor chamber systems.

Backfill Material Requirements

The foundation and embedment stone, shown in Figure 1, comprise the areas beneath, around, and above the HydroStor chambers and endcaps. The backfill material within these zones must be:

- Class I Stone
- Clean
- Crushed
- Angular
 - Meet either the size or gradation requirements, respectively:
 - o ³⁄₄" − 2"
 - AASHTO M43 Size 3, 357, 4, 467, 5, 56, 57 (see attached gradation table for further information)



Figure 1: HydroStor Chamber System Cross Section

The size and cleanliness attributes of the rock allows the porosity (void space) to be 40% for additional storage in the stone, where the crushed and angular attributes ensure that the backfill is locking together for proper structural support and limiting the potential for chamber shifting and/or settlement during both live and dead load events.



For further clarification of the angularity requirement of the backfill, see the criteria for each classification shown in Table 1 below. A visual representation of this information is shown in Figure 2.

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

Table 1: Criteria for Describing Angularity









Angular

Subangular

Subrounded

Rounded

Figure 2: Visual Angularity Representation



Acceptable Backfill Materials

Three backfill materials that typically meet the acceptable backfill requirements are shown below in Figures 3-5. Note that aggregate varies widely by region and supplier. An aggregate labeled as one of the names below may not meet all requirements for acceptable backfill. All backfill should be verified prior to installation.



Figure 4: Granite



Figure 3: Trap Rock



Figure 5: "Hard" Limestone

For limestone to be considered "hard" and acceptable backfill, the following additional material requirements must be met and verified through their respective testing procedures:

- Maximum loss of 40% in the LA Abrasion Test (per AASHTO T 96 or approved equal)
- Maximum 12% loss after 5 cycles in magnesium sulfate solution (per AASHTO T 104 or approved equal)



Unacceptable Backfill Materials

Three backfill materials that typically do not meet the acceptable backfill requirements are shown below in Figures 6-8.



River rock is not acceptable as it is not angular. The rounded stone will not lock together properly allowing for potential shifting of chambers and/or stone.

Figure 6: River Rock



Crushed river rock may not be acceptable as it typically is not proper size and angularity. While there are angular faces on some of the stone, most of the faces remain rounded allowing for potential shifting of chambers and/or stone.

Figure 7: Crushed River Rock



Figure 8: "Soft" Limestone

"Soft" limestone is limestone not conforming to the additional material requirements mentioned under "hard" limestone. Without proper hardness of the stone, crumbling may occur over time allowing for potential shifting of chambers and/or stone.



Conclusion

There are numerous types of backfills available on the market, however not all backfill materials meet the requirements for use with Prinsco's HydroStor chamber systems. In addition to size, angularity and hardness can vary greatly from sample to sample. With this in mind, it is important that all backfill be evaluated prior to installation to guarantee the integrity and longevity of the HydroStor chamber system. If a backfill selection is in question, please contact your local Prinsco sales representative for support.

Reference Specifications

- AASHTO M43 Standard Specification for Sizes of Aggregate for Road and Bridge Construction
- AASHTO T 96 Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- AASHTO T 104 Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

Acceptable Embedment and Foundation Stone Gradation Sizes of Coarse Aggregate																
Size	Nominal size	Image: Construction of the sector of the														
number	square openings (1)	4	3-1/2	3	2-1/2	2	1-1/2	1	3/4	1/2	3/8	No. 4	. 0 No. 8	No. 18	No. 50	No. 100
1	3-1/2 to 1-1/2.	100	90 to 100		25 to 60		0 to 15		0 to 5							
2	2-1/2 to 1-1/2			100	90 to 100	35 to 70	0 to 15		0 to 5							
24	3-1/2 to 3/4.			100	90 to 100		25 to 60		0 to 10	0 to 5						
3	2 to 1.				100	90 to 100	35 to 70	0 to 15		0 to 5						
357	2 to No. 4.				100	95 to 100		35 to 70		10 to 30		0 to 5				
4	1-1/2 to 3/4.					100	90 to 100	20 to 55	0 to 15		0 to 5					
467	1-1/2 to No. 4.					100	95 to 100		35 to 70		10 to 30	0 to 5				
5	1 to 1/2						100	90 to 100	20 to 55	0 to 10	0 to 5					
56	1 to 3/8						100	90 to 100	40 to 75	15 to 35	0 to 15	0 to 5				
57	1 to No. 4.						100	95 to 100		25 to 60		0 to 10	0 to 5			
6	3/4 to 3/8.							100	90 to 100	20 to 55	0 to 15	0 to 5				
67	3/4 to No. 4							100	90 to 100		20 to 55	0 to 10	0 to 5			
68	3/4 to No. 8							100	90 to 100		30 to 65	5 to 25	0 to 10	0 to 5		
7	1/2 to No. 4								100	90 to 100	40 to 70	0 to 15	0 to 5			
78	1/2 to No. 8.								100	90 to 100	40 to 75	5 to 25	0 to 10	0 to 5		
8	3/8 to No. 8									100	85 to 100	10 to 30	0 to 10	0 to 5		
89	3/8 to No. 16.									100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5	
9	No. 4 to No. 16										100	85 to 100	10 to 40	0 to 10	0 to 5	
10	No. 4 to 0 (2)										100	85 to 100				10 to 30

(1) In inches, except where otherwise indicated. Numbered sieves are those of the United States Standard Sieve Series.

(2) Screenings.

Where standard sizes of coarse aggregate designated by two or three digit numbers are specified, the specified gradation may be obtained by combining the appropriate single digit standard size aggregates by a suitable proportioning device which has a separate compartment for each coarse aggregate combined. The blending shall be done as directed by the Laboratory.