Development and Implementation of a Quality Control System for Bentonite Materials

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This work describes the development and implementation of a quality control system for bentonite material from initial acquisition to processing. The system is designed to provide an efficient, cost-effective, and reliable means of ensuring the sufficient quality of bentonite destined for use in the engineered barrier system of a repository for spent nuclear fuel. The program is outlined in figure 1 and includes three test categories: Basic Acceptance Testing, Advanced Acceptance Testing, and Complementary Testing.

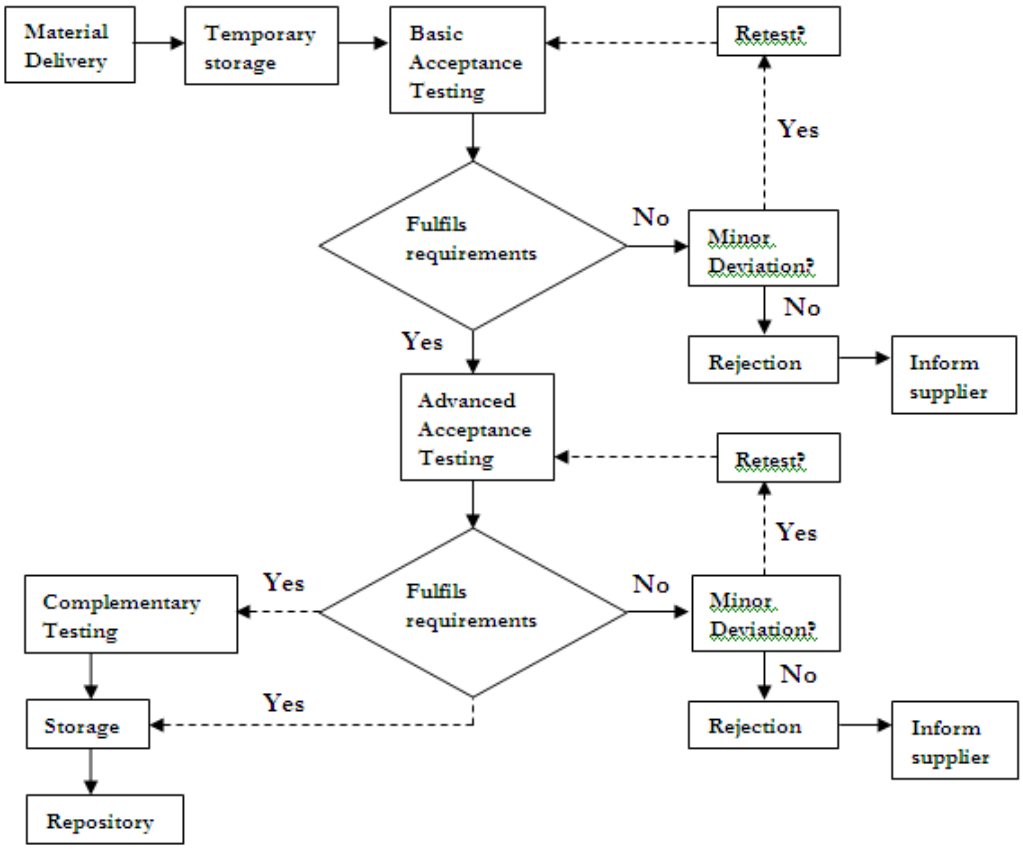

Figure 1. *Quality control process for bentonite material [modified from Ahonen et al. 2008]*

Basic acceptance testing is to be performed for any and all bentonite material considered for use in the repository. These tests are designed to quickly determine whether the material meets at least a basic level of acceptance. If the material passes basic acceptance testing, it progresses to the advanced acceptance testing regime. If the acquired material originates over multiple source lots, basic and advanced acceptance testing are performed for each. Complementary testing is performed when necessary or requested.

B+Tech has developed the in-house capability and competence to perform the majority of the tests and built a network (in Finland) of reliable, external partners and providers for the remainder. The specific test methods are listed in table 1.

Table 1. *Test methods used in quality control of bentonite materials.*

A)	**Basic Acceptance Testing:**
-	Water Ratio
-	Swelling Index
-	Liquid Limit
-	CEC
-	Grain Size Distribution (dry sieving)
B)	**Advanced Acceptance Testing:**
-	Swelling Pressure
-	Hydraulic Conductivity
-	Mineralogy: quantitative XRD, optical microscopy
-	Chemical Composition: ICP/AES, LOI, Leco (Total S, inorg. and org. C), IC (SO_4^{2-})
-	Grain Density
-	Thermal Conductivity
C)	**Complementary testing:**
-	Water Absorption Capacity (Enslin-Neff)
-	Plastic limit
-	Mineralogy: FTIR, Greene-Kelly Test
-	Purified Material Tests: ICP/AES, CEC, CBD-extraction, Na_2CO_3-extraction
-	Specific Surface Area (EGME, BET)
-	Grain Size Distribution (sedigraph)
-	Exchangeable Cation Analysis
-	Unconfined Compression Tests (compressive strength, shear strength)
-	Beam Test (tensile strength)
-	Proctor Compaction Test
-	Water Retention Properties

References:

Ahonen L., Korkeakoski P., Tiljander M., Kivikoski H., Laaksonen R., 2008, Quality Assurance of the Bentonite Material. *Posiva Working Report 2008-33*, Eurajoki, Finland.