

Case Study: The Performance of Louvered Screen and Non-Select Filter Pack Material

Introduction

The generally accepted criteria for filter pack material suitable for use in gravel envelope water wells is for it to be composed of well-rounded, water-worn siliceous rock washed free of deleterious matter. Many designers specify that the midsize of the pack material should be about 4 to 6 times larger than the midsize of the aquifer. Filter packs that meet such criteria are herein referred to as "select". Select filter pack materials are readily available in the U.S. from commercial aggregate suppliers who typically offer a variety blended materials to meet specific size parameters. However, the fact is that select materials are not always available. For instance, well drilling contractors working in rural areas or overseas seldom use select filter pack materials. They have no recourse but to use locally available aggregate that is angular, calcareous, randomly sorted, and rife with deleterious matter. Such was the case in the Republic of the Philippines where a score of gravel envelope wells were installed.

This memorandum presents a narrative describing a major ground water development project that relied upon the performance of louvered well screen to overcome the inherent negative characteristics of non-select filter pack materials.

The Program

The Metropolitan Water Works and Sewage System (MWSS), the principal water utility for metropolitan Manila, meets a large portion of its daily water demand by pumping ground water from a network of deep wells located throughout Metro Manila and the Marikina Valley. As the population of Metro Manila increased, MWSS had to increase its water supply. It began by upgrading the well system. MWSS funded a two-part program that consisted of 1) rehabilitating existing wells and 2) drilling new wells. MWSS embarked upon a major ground water development program and drilled 25 high-capacity production wells in the span of about 30 months.

Part 1 - Redeveloping Existing Wells

MWSS had a large system of production wells that had been poorly maintained. Therefore, the initial effort was to rehabilitate approximately 60 existing wells. Many existing wells dated back to the end of WWII, had been drilled by cable-tool rigs, and were completed with mill's knife perforations. In general, they were generally no longer serviceable. Approximately 60 wells less than 20 years old had been drilled by mud-rotary rigs and were completed with mill-slotted casing. Those wells were scheduled for rehabilitation.

MWSS records showed that all of the mill-slotted wells had severely lost production capacity. Downhole surveys showed that this was due to clogging. Aggressive redevelopment the mill-slotted wells by wire-brushing and surging with a tight-fitting swab proved fruitless. It was obvious that the slots were so badly plugged with silt and fine sand that wire-brushing and surging were ineffective.

Part 2 - New Well Construction

Based on the rehabilitation results, MWSS elected to use a more efficient type of well screen for new wells. At that time, Roscoe Moss Company was just beginning to introduce louvered well screen to the Philippines. MWSS and its consultant decided to design new production wells with louvered screen and prepared specifications for 0.2% copper-bearing steel, 14" to 18" diameter, and slot size of 0.090".

The wells were designed as gravel envelope wells with non-select filter pack placed around the well screen. At the time that MWSS launched the well construction program, gravel envelope wells were uncommon in Metro Manila. In fact, there were no commercial suppliers of gravel, thus no readily available blends of gravel that would meet typical U.S. criteria for a graded filter packs. Therefore, when the wells were designed, there was no alternative but to relax the criteria for filter packs. Design specifications for the new wells were written to allow the use of non-select (i.e., angular, highly calcareous, and poorly sorted) filter packs.

MWSS was initially hesitant to use locally the available, angular gravel and coarse sand filter pack material. However, the results showed that the non-select pack actually worked very well with louvered screen. Why? The answer was the slot geometry of the louvers. The downward facing louvers were able to accommodate the angular material and they did not clog when the aggregate was placed.

During construction the contractors found that they were able to free-fall the filter pack and consolidate it by swabbing through the louvered screen. (Gravel pumps were not available). No significant bridging problems were experienced. The contractors simply consolidated the filter pack with a tight-fitting swab. They found that the consistent internal diameter of the louvered screen allowed the swab to transmit flow energy through the louvers and into the annulus. When measurements were made in the annulus down to the top of the filter pack during pumping, the results showed that the pack had been well consolidated during its installation and mechanical development.

SUMMARY

The MWSS ground water development program demonstrated several key differences between performances of mill-slotted casing and louvered well screen. First, gravel envelope wells should be constructed with select aggregate. However, if one must use non-select material, it should be comforting to know that the geometry of louvered screen can accommodate it. Second, while using mill-slotted screen will cost less initially than louvered screen, those savings will overshadowed by the poor long-term performance and efficiency of mill-slotted screen.

About the Author

Robert Turnbull is the Chief Hydrogeologist of Roscoe Moss Company. In this capacity he provides technical support, as needed, to consultants, municipalities, and water districts to plan and design water supply wells. He can be contacted for such information or to answer inquires regarding this technical memorandum via email at rturnbull@roscoemoss.com. His website is www.blhydro.com. The corporate website for Roscoe Moss Company is www.roscoemoss.com.

