

When Filter Media Meets Specification but Commissioning Still Hurts: Lessons from Recent GAC and BAC Installations

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Abstract

Filter media replacement is an infrequent but critical activity for water treatment plants, often occurring only once every 10–15 years. When challenges arise during commissioning or early operation, they can place considerable pressure on operators and process teams to make decisions quickly, sometimes with limited confidence, even where media has met specification and testing requirements.

This paper reflects on recent experiences across several water treatment facilities where new granular activated carbon (GAC) and biological activated carbon (BAC) media complied with relevant specifications and third-party testing, yet operational issues still emerged. These included unexpected headloss behaviour, difficulties returning filters to service after backwashing, and uncertainty around whether observed behaviour was normal, temporary, or indicative of a deeper issue with the media or operation.

Rather than focusing on standards or compliance frameworks, the presentation explores these experiences from an operational perspective, with an emphasis on understanding why challenges can still occur and what information may help reduce uncertainty during commissioning. Key themes include the timing and interpretation of test results, linking laboratory data to observed filter behaviour, and the risk of losing valuable operational knowledge between long media replacement cycles.

The aim of this presentation is to share practical lessons learned, highlight early signals operators can watch for, and encourage discussion around how experiences from recent projects can be better captured and shared. By doing so, it is hoped future media replacements can be approached with greater confidence and support for operations teams.

Introduction

Granular filtration systems play a critical role in the reliable production of safe drinking water. In many modern treatment plants, granular activated carbon (GAC) and biological activated carbon (BAC) filters are used to remove natural organic matter, taste and odour compounds, and other trace contaminants. The effectiveness of these systems is therefore closely linked to the behaviour and physical characteristics of the filter media within the filter bed.

Over time, filter media can gradually lose effectiveness and may be replaced to maintain treatment performance. Media replacement therefore represents a significant maintenance activity for treatment plants. Although this occurs relatively infrequently, it introduces a period during which the performance of the filtration system may differ from established operating conditions. Operators and process teams must manage this transition while maintaining water production and ensuring treated water quality remains within required limits.

Because filter performance depends on a combination of factors including - the media itself, the way the filters are operated, and the hydraulics of the plant - replacing filter media can sometimes introduce a period of uncertainty during commissioning. It may take some time for operators to understand how the new media behaves compared with the previous filter bed. Recognising how

these factors influence filter performance can help operators interpret what they are seeing during early operation.

Overview of Media Specifications and Testing

Utilities typically rely on established specifications and testing requirements when procuring filter media. Standards such as ANSI/AWWA B604 for granular activated carbon, ANSI/AWWA B100 for granular filter media and NSF/ANSI 61 for drinking water system components define a range of physical and chemical properties that materials must meet before being used in drinking water treatment applications.

Typical specification parameters include particle size distribution, effective size and uniformity coefficient, density, moisture content, abrasion resistance and iodine number for activated carbon. In addition, testing may be undertaken to assess potential impurities and evaluate the potential for materials to leach contaminants into drinking water.

These specifications are commonly supported by supplier certificates of analysis and, in many cases, independent third-party laboratory verification prior to delivery to site. By defining acceptable ranges for key parameters and requiring verification of supplied materials, utilities can confirm that the media being installed is consistent with the product that was specified.

While these requirements play an essential role in managing procurement risk and protecting drinking water quality, they are primarily designed to confirm product properties rather than to predict how media will behave within a specific filtration system. Full-scale filter performance is influenced by plant-specific factors such as hydraulic loading, backwash conditions, filter underdrain configuration and operational practices.

As a result, media that meets all specification and testing requirements may still behave differently during commissioning or early operation. Understanding this distinction between material compliance and operational behaviour is an important aspect of interpreting filter performance during media replacement projects.

Case Experiences: Filter Media Replacement in Practice

The following case experiences illustrate how these challenges can arise in practice during filter media replacement projects

Case Study 1 – Commissioning Uncertainty Following Full Filter Refurbishment

In one recent water treatment plant refurbishment project, filters underwent a complete overhaul, including replacement of both the granular activated carbon (GAC) media and the filter nozzle system. The media was supplied and installed as part of the refurbishment works, however third-party testing of the carbon was not completed prior to commissioning and certificates of analysis were not immediately available at the time the plant was returned to service.

Shortly after commissioning, operators began observing unusual filter behaviour, including elevated headloss during operation and instability in filter performance. As the filters had undergone multiple changes simultaneously (including new nozzles and new media), it was not immediately clear whether the observed issues were related to the carbon media, the hydraulic performance of the filter underdrain system, or other operational factors.

Because the plant needed to return to production quickly, the operations team faced significant pressure to diagnose the issue while maintaining supply. Independent laboratory testing of the

carbon was subsequently arranged alongside testing by the supplier to confirm whether the media met the specified requirements.

In hindsight, the investigation determined that the operational issues were related to the replacement nozzle system rather than the carbon media itself. However, without independent verification of the media prior to commissioning, the carbon remained a potential source of concern during the early stages of troubleshooting.

Reflecting on the experience, plant staff indicated that earlier independent testing of the media could have provided greater confidence that the carbon itself was compliant, allowing investigation efforts to focus more quickly on other potential causes. In addition, staged testing during the refurbishment process — for example verifying system performance following nozzle replacement before loading new media — may have reduced uncertainty during commissioning.

Case Study 2 – Managing Procurement Risk Through Early Media Testing

A different approach was taken at another facility where granular activated carbon media was being replaced as part of routine filter maintenance. In this case, the project team required independent third-party testing of the media prior to installation to verify compliance with the specified parameters.

During the procurement process, testing identified several non-conformances in supplied media batches, requiring the product to be remanufactured and resupplied before installation could proceed. While this created delays in the delivery schedule, it ensured that the final product installed in the filters met the required specification.

In addition to laboratory testing, the project team also conducted pilot plant trials using samples of the supplied carbon prior to full-scale installation. These trials provided valuable insight into operational aspects of commissioning the new media. In particular, the pilot plant testing highlighted differences in commissioning behaviour between washed and unwashed carbon as supplied by the manufacturer.

The trials also reinforced the importance of completing the initial backwashing sequence prior to opening the outlet valve and placing the filter into service. During one pilot run, a control system glitch allowed the filter to enter filtration mode before the media had been adequately backwashed. This resulted in carbon fines blocking the retention plate in the pilot unit, requiring extensive backwashing to restore normal operation.

These observations provided useful guidance for the commissioning process and helped inform operational procedures during full-scale installation.

In this particular case the manufacturing plant supplying the carbon was located in the same city as the treatment plant. This significantly reduced transport times and allowed for relatively rapid replacement of non-conforming batches. As a result, although the project experienced some schedule delays during procurement, the commissioning phase itself proceeded without major operational difficulties.

However, this situation also highlighted a potential challenge for many utilities. Where suppliers are located further away or rely on international supply chains, the identification of non-conforming media after production can result in substantial delays due to manufacturing lead times and transport logistics.

This case demonstrates that early verification of media compliance can significantly reduce operational risk during commissioning. At the same time, it also highlights the practical challenges that can arise when non-conforming product is identified late in the supply process.

Industry Perspective – Managing Infrequent but High-Consequence Activities

Discussions with several utilities have highlighted another challenge associated with filter media replacement: the infrequent nature of the activity itself. Media replacement may occur only once every decade or longer for a given plant. As a result, the individuals responsible for specifying, procuring or commissioning filter media may not have recent experience to draw upon when these projects arise.

Utilities noted that while existing standards and testing frameworks provide important safeguards, the practical knowledge gained during commissioning — such as recognising normal filter behaviour, interpreting testing results, or identifying early warning signs — may not always be formally captured and transferred to future projects.

This creates an opportunity to better document and share operational lessons so that future media replacement projects can be approached with greater confidence.

Observations and Common Themes

Reviewing experiences across several recent filter media installations reveals a number of recurring themes that influence operational confidence during commissioning.

Compliance Does Not Always Translate to Operational Confidence

In all cases discussed, the supplied media was ultimately shown to meet the required specification. However, this did not necessarily prevent uncertainty during commissioning when unexpected filter behaviour occurred.

Operators faced the challenge of distinguishing between normal commissioning effects and indicators of a potential problem. Without clear expectations for early filter behaviour, it can be difficult to determine when intervention is necessary.

Timing of Information and Verification

The timing of testing and verification can significantly influence the commissioning experience.

Where independent testing was not completed prior to commissioning, the media remained a potential source of concern during troubleshooting, even if it was ultimately not responsible for the observed issues. Conversely, where testing was conducted earlier in the procurement process, operational confidence during commissioning was improved, although this sometimes introduced delays where non-conforming batches were identified.

This highlights the balance between procurement timelines, testing logistics and operational risk.

Interpreting Filter Behaviour During Early Operation

Operators from multiple sites reported uncertainty around how new carbon media should behave during the early stages of operation. Several commonly observed behaviours were discussed:

- floating carbon or buoyant particles appearing in filters following initial loading
- carbon fines being present in backwash water for extended periods after commissioning

- unexpected headloss behaviour or instability in filter performance
- water quality concerns related to leachable components such as aluminium

In many cases these observations raised questions about whether the behaviour represented normal commissioning effects, operational practices, or potential issues with the supplied media.

Commissioning Practices and Media Handling

Operational practices during commissioning may also influence early filter behaviour. In several instances, plants undertook frequent or vigorous backwashing in an attempt to remove fines from newly installed carbon. While this approach may help remove loose material, there is also discussion within the industry about whether aggressive backwashing or early air scouring may contribute to additional media breakdown during the first stages of operation.

Similarly, some operators noted that air scour during early commissioning may influence the stability of newly installed media beds before the carbon has fully settled or biological systems have begun to establish.

These observations suggest that commissioning practices themselves may play an important role in early filter behaviour and may warrant further consideration when new media is installed.

Knowledge Loss Between Media Replacement Cycles

Finally, utilities highlighted the difficulty of retaining operational knowledge between media replacement cycles. As these projects occur relatively infrequently, the lessons learned during commissioning may not always be documented or readily available when the next replacement occurs.

Capturing and sharing these experiences may therefore help improve confidence and decision-making during future filter media installations.

Role of Existing Standards in Managing Media Quality

It is important to note that many of the operational concerns discussed above are already addressed to some extent within existing filter media standards. For example, ANSI/AWWA B604 includes limits on non-wettable materials (often referred to as “wettables”), which are intended to reduce the presence of floating carbon particles. Similarly, NSF/ANSI 61 and EN 12902 include requirements relating to the potential for materials to leach contaminants into drinking water.

These provisions play an important role in managing product quality and protecting water supplies. However, the parameters defined in standards are primarily designed to ensure material safety and consistency, rather than to fully predict how media will behave in every treatment plant configuration. As a result, even where supplied media complies with the relevant standards, operators may still observe behaviours during early commissioning that require interpretation and operational judgement.

In practice, laboratory specifications and operational behaviour represent two complementary aspects of filter media performance. While standards provide an essential baseline for product quality and safety, operational experience remains important for understanding how those materials behave within specific plant conditions.

Observation	Operational Implication	Potential Mitigation
Media that meets specification may still produce unexpected filter behaviour during commissioning	Operators may initially be uncertain whether behaviour is normal or indicative of a problem	Allow time for observation and monitoring during early operation and consider independent verification of media properties
Absence of early media verification can complicate troubleshooting	Media may remain a suspected cause of operational issues even when other components are responsible	Where practical, verify key media parameters prior to installation
Early testing may identify non-conforming product before installation	Procurement schedules may be affected if replacement batches are required	Plan testing timelines within procurement schedules where possible
Commissioning multiple filter components simultaneously can increase diagnostic uncertainty	Difficult to determine whether issues relate to media, hydraulics or filter hardware	Where possible, stage commissioning activities (e.g. verify hydraulics before loading media)
Newly installed carbon may exhibit temporary behaviours during early operation	Floating carbon, fines in backwash or headloss changes may occur while the media bed stabilises	Monitor filter behaviour and allow time for the media bed to settle
Aggressive backwashing or early air scour may influence media stability	Excessive cleaning during early operation may contribute to additional fines generation	Review commissioning procedures to balance fines removal with media stability
Pilot plant trials can provide insight into commissioning behaviour	Operational procedures may be refined before full-scale installation	Consider pilot testing representative media samples where feasible
Media replacement occurs infrequently	Operational knowledge may be lost between replacement cycles	Document commissioning experiences to support future projects

Table 1: Key Lessons from Recent Filter Media Commissioning Experiences

Practical Lessons for Operators and Utilities

The experiences discussed in this paper highlight that filter media replacement can involve a combination of procurement, operational and commissioning considerations. While every treatment plant operates under different conditions, several practical lessons emerged that may help support future media replacement projects.

Consider the Timing of Media Verification

Where possible, verification of key media parameters prior to installation can help provide confidence during commissioning. Early confirmation that the supplied product meets the specified

requirements may allow operators and project teams to focus their attention on other potential causes if unexpected behaviour occurs during early operation.

At the same time, utilities should be aware that identifying non-conforming media late in the procurement process may introduce logistical challenges, particularly where manufacturing or transport lead times are significant. Balancing early verification with practical supply chain considerations is therefore an important aspect of project planning.

Pilot plant trials using representative media samples can provide valuable insight into commissioning behaviour and help refine operational procedures prior to full-scale installation.

Separate Major Commissioning Changes Where Possible

Where filter refurbishment involves multiple changes (such as underdrain replacement, nozzle upgrades and media replacement), staged commissioning may help reduce uncertainty. Verifying the hydraulic performance of the filter system prior to loading new media may allow issues to be identified and resolved before additional variables are introduced.

Recognise That Early Filter Behaviour May Differ from Mature Operation

Operators reported that newly installed carbon media can exhibit behaviours that differ from established filter beds. These may include the presence of floating particles, the release of fines during early backwashing, or variations in headloss behaviour while the media bed settles and biological processes begin to establish.

Understanding that these behaviours may occur during early operation can help operators interpret filter performance and determine whether intervention is required.

Review Commissioning and Backwashing Practices

Commissioning procedures may influence the early performance of newly installed media. In several cases, operators undertook frequent or aggressive backwashing in an effort to remove fines from new carbon. While this may assist in removing loose particles, some operators have questioned whether highly vigorous backwashing or early air scouring may contribute to additional media breakdown during the early stages of operation.

These experiences suggest that commissioning practices should be carefully considered to ensure they support stable media bed development while still removing undesirable fines.

Capture Lessons for Future Media Replacement

Finally, utilities highlighted the importance of documenting operational experiences during filter media commissioning. Given the long intervals between media replacement projects, capturing observations, lessons and troubleshooting approaches may provide valuable guidance for future operators and project teams when similar projects arise.

Conclusion

Filter media replacement represents an infrequent but significant activity for water treatment plants. Although established standards and testing requirements provide an important foundation for ensuring media quality and protecting drinking water supplies, recent experiences demonstrate that compliance with specification does not always translate directly into operational confidence during commissioning.

The case experiences discussed in this paper highlight how operational uncertainty can arise when unexpected filter behaviour occurs following installation of new media. In these situations, operators may need to make important decisions quickly while balancing production demands, water quality considerations and incomplete information about the causes of observed behaviour.

These experiences suggest that while laboratory testing and specifications remain essential tools for managing procurement risk, they represent only one part of the broader picture of filter performance. Interpreting how new media behaves within the context of a specific treatment plant requires operational judgement and experience.

Capturing and sharing these experiences may help reduce uncertainty during future media replacement projects. By combining the strengths of established testing frameworks with practical operational knowledge, utilities can approach filter media commissioning with greater confidence and support for the teams responsible for managing these critical assets.

Continued discussion and sharing of commissioning experiences across utilities may help ensure these lessons are not lost between the long intervals of filter media replacement 😊