MATERIALS MATTER

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Beware marketing pieces masquerading as technical content

White papers can be a useful source of new technology information, but sometimes caution should be exercised relative to claims made.

In the world of digital publishing, there is a great deal of content that is put out into the public domain every day. The spread of information and ideas can be an excellent advantage to new companies and technologies looking to inform new prospects and customers of their capabilities and benefits. But it is important to use caution when evaluating these sorts of white papers and articles.

White papers are a great way to quickly summarize information, a limited case study, or general technology characteristics. They do not typically require citations, peer review, or the like. They can be rapidly crafted and published for the world to see. The gear industry is generally not one that sees drastic changes to its manufacturing technology. This slow evolution (rather than revolution) dynamic is largely a result of how mature gear manufacturing technology is. Now, this "evolutionary" change dynamic is not meant to suggest that gear-manufacturing technology is not advancing in meaningful and significant ways. Newer, more advanced machine tools seem to come to market every year, and these machine tool advancements, while perhaps not as exciting to the average public as more emerging industries such as additive manufacturing, serve to improve gear quality in tangible and reliable ways. Whether these advancements result in increased throughput, higher first pass yield, or the ability to fabricate more challenging gear geometries, there is no question that the machine tools are more capable than the machine tools of five, 10, and 20 years ago. As such, white papers and marketing content in the gear industry generally are reliable and come with little risk to the reader. Blatantly (or even subtly) false or exaggerated claims will quickly be brought to light, given the breadth and depth of existing expertise amongst the many gear manufacturing and gear industry professionals.

Surface finishing, however, is not such a mature or well-studied market. It is true that many of the known surface finishing technologies, such as the myriad of non-machining abrasive finishing technologies (tumbling, barreling, etc.) have existed for decades (if not centuries). Even REM's chemically accelerated processes (albeit early versions) have existed for more than 30 years, with our first patents being granted in the mid to late 1980s. However, this area of manufacturing has largely not garnered the attention and technical study that primary gear-forming operations (such as hobbing, grinding, and the like) have. Non-machining surface finishing (i.e. processes that do not involve precision machine tool path-guided material removal) and even the measurement of surface roughness have long been left to side with generally limited study. Some of REM's previous Materials Matter columns were motivated by this lack of surface measurement study and understanding. A Google Scholar search for

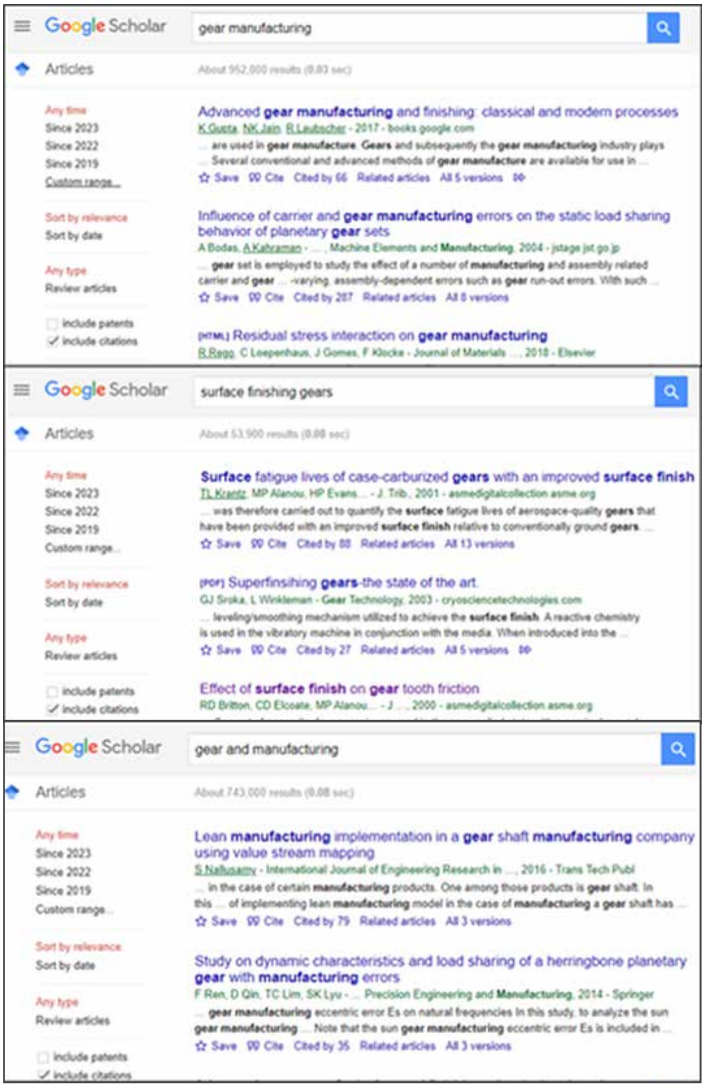


Figure 1: Google Scholar search examples. (Courtesy: REM Surface Engineering)

"gear manufacturing"/"gear" and "manufacturing" yields between 700,000 and 1 million results; conversely, a search for "surface finishing gears"/ "gears" and "surface finishing" yields results in the range of 6,000 to 50,000 (Figure 1).

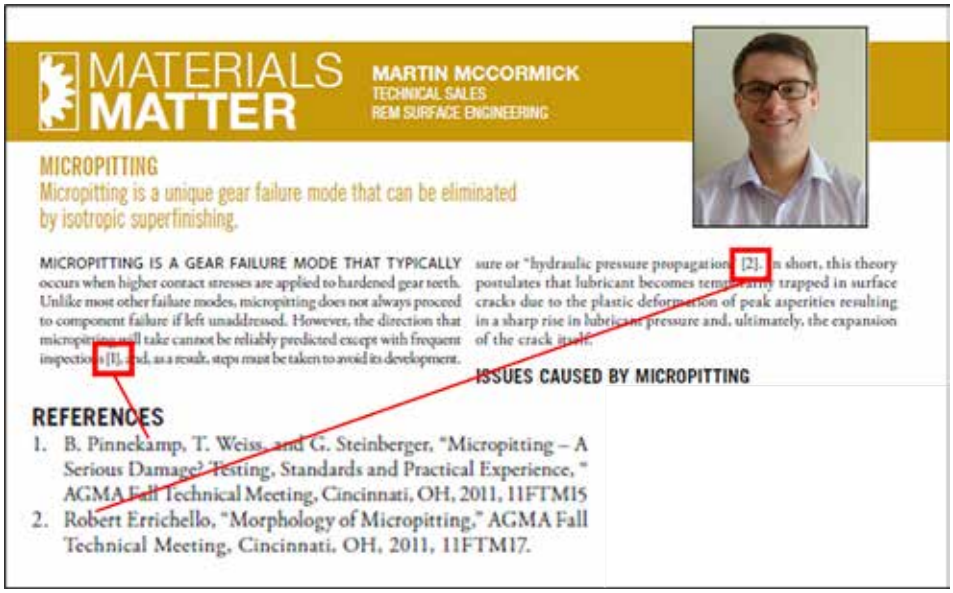
Beyond having substantially less technical study, non-machining gear surface finishing processes also tend to garner less attention on the manufacturing floor. Having worked in and around the gear manufacturing industry for almost 20 years now, I can state that, from my own experience, surface finishing processes are often treated in one of two ways: as generally ignored processes that may have limited controls in place or as some kind of "dark arts" where a few employees may understand the process in depth and are relied upon heavily to ensure process quality is maintained. I can further state that I have

attended more than one customer visit where REM was called in to address a potential process technology issue (typically part damage), only to find that the issue was much more simply a lack of process maintenance/process understanding. In REM's case, a typical example of this lack of process understanding is allowing the processing media in a vibratory processing apparatus to fall below the required level to maintain part separation and ensure a gentle tumbling motion. In some cases, REM has observed vibratory bowls with less than half of the recommended level present! My colleague, Bill Nebiolo, discusses this and other process maintenance requirements in his Materials Matter column, "Vibratory Bowl Gear Polishing Inefficiencies," in the April 2022 *Gear Solutions*. All of this is to say that the surface finishing industry and, more specifically, the gear surface finishing industry are very different landscapes as compared to the broader gear manufacturing industry.

Given these differences, gear surface finishing white papers must be viewed in a different fashion than perhaps gear manufacturing white papers/articles can be viewed. When reviewing surface finishing white papers or articles, readers should understand that these publications are likely being written primarily from a marketing perspective. This statement does not necessarily mean that the data, benefits, or claims presented are wrong or untrue, but there is a better-than-average chance that this presented information is either incomplete or is based on very limited testing.

So, what would I recommend when reading these sorts of surface-finishing articles? Should these articles/white papers all simply be ignored? No, of course, we should not simply ignore all such articles as many likely carry some useful information. However, we should be careful with how we treat the presented information. Further, there are a few things you can look for in these types of white papers or articles to gauge how complete and/or trustworthy they are likely to be.

First and foremost, if the white paper or article summarizes a peer-reviewed and published/presented technical paper or presentation, then the article is likely to be mostly trustworthy. Given that technically reviewed source material is available, a reader can easily dive deeper into the presented information to better understand and validate the claims made in the white paper. A close second is if the white paper uses citations for other technical publications from well-known and trustworthy sources to support the claims, benefits, or conclusions (Figure 2). Again, much as when the reader can review the source material, here the reader can review these technical citations to verify the accuracy of the claims being made in the white paper. If there are no technical citations or peer-reviewed source material, a white paper can still present meaningful technical data to support any claims or conclusions that are being drawn.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MICROPITTING
Micropitting is a unique gear failure mode that can be eliminated by isotropic superfinishing.

MICROPITTING IS A GEAR FAILURE MODE THAT TYPICALLY occurs when higher contact stresses are applied to hardened gear teeth. Unlike most other failure modes, micropitting does not always proceed to component failure if left unaddressed. However, the direction that micropitting will take cannot be reliably predicted except with frequent inspections [1], and, as a result, steps must be taken to avoid its development.

sure or "hydraulic pressure propagation" [2]. In short, this theory postulates that lubricant becomes temporarily trapped in surface cracks due to the plastic deformation of peak asperities resulting in a sharp rise in lubricant pressure and, ultimately, the expansion of the crack itself.

ISSUES CAUSED BY MICROPITTING

REFERENCES

1. B. Pinnekamp, T. Weiss, and G. Steinberger, "Micropitting – A Serious Damage? Testing, Standards and Practical Experience," AGMA Fall Technical Meeting, Cincinnati, OH, 2011, 11FTM15
2. Robert Errichello, "Morphology of Micropitting," AGMA Fall Technical Meeting, Cincinnati, OH, 2011, 11FTM17.

Figure 2: Example of a white paper using technical publication citations. (Courtesy: REM Surface Engineering)

This sort of supporting data should not be given the same level of credibility as the referenced, peer-reviewed source material, and it is suggested to the reader to proceed with caution since there is no way to verify the veracity of the claims. Moreover, these types of publications must not be used as a reputable source to be cited in a future article or publication. However, depending on the sample size and the quality (and detail) of the data, a reader can likely make an informed judgment on the veracity of the associated claims/conclusions.

Finally, if a white paper lacks any or all of these three elements and presents otherwise not widely accepted data or claims, a reader would be well served to proceed with extreme caution. A key giveaway that a publication may not be technically sound is the consistent use of hyperboles; remember, big claims require enormous evidence to be supported. Other possible giveaways include articles that do not mention the technology's limitations (it sounds like a fairy tale with a happy ending), charts or graphs are presented without error bars, no statistical relevance is established in the data analysis and discussion, and significant extrapolation of results to reach to a conclusion is presented based on limited data.

As a closing statement, we would do well to remember the wise words of Carl Sagan: "If we are not able to ask skeptical questions, to interrogate those who tell us that something is true, to be skeptical of those in authority, then, we are up for grabs for the next charlatan who comes rambling along."

ABOUT THE AUTHOR

Justin Michaud is president and CEO of REM Surface Engineering, where he works closely with the research team, supports REM's government projects and awards, and focuses heavily on REM's surface finishing solutions for metal additive manufacturing applications. Michaud serves on the American Gear Manufacturers Association (AGMA) Emerging Technology Committee and is the chair to the 3D Printing sub-committee. He is an author of multiple technical papers on topics including additive manufacturing, isotropic superfinishing, gear failure modes, surface texture and measurement, high value gear repair, and the superfinishing of high hardness steels.