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DEPARTMENT OF COMMERCE

Bureau of Industry and Security

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Publication of a Report on the Effect of Imports of Titanium Sponge on the National Security: An Investigation Conducted Under Section 232 of the Trade Expansion Act of 1962, as Amended

AGENCY: Bureau of Industry and Security, Commerce.

ACTION: Publication of a report.

SUMMARY: The Bureau of Industry and Security (BIS) in this notice is publishing a report that summarizes the findings of an investigation conducted by the U.S. Department of Commerce (the "Department") pursuant to Section 232 of the Trade Expansion Act of 1962, as amended ("Section 232"), into the effect of imports of titanium sponge on the national security of the United States. This report was completed on November 29, 2019 and posted on the BIS website in July 2021. BIS has not published the appendices to the report in this notification of report findings, but they are available online at the BIS website, along with the rest of the report (*see* the ADDRESSES section).

DATES: The report was completed on November 29, 2019. The report was posted on the BIS website in July 2021.

ADDRESSES: The full report, including the appendices to the report, are available online at https://bis.doc.gov/232.

FOR FURTHER INFORMATION CONTACT: For further information about this report contact Erika Maynard, Special Projects Manager, (202) 482-5572; and Leah Vidovich, Management and Program Analyst, (202) 482-1819. For more information about the Office of Technology Evaluation and the Section 232 Investigations, please visit: http://www.bis.doc.gov/232.

SUPPLEMENTARY INFORMATION:

THE EFFECT OF IMPORTS OF TITANIUM SPONGE ON THE NATIONAL SECURITY

AN INVESTIGATION CONDUCTED UNDER SECTION 232 OF THE TRADE EXPANSION ACT OF 1962, AS AMENDED

U.S. Department of Commerce
Bureau of Industry and Security
Office of Technology Evaluation

November 29, 2019

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Prepared by Bureau of Industry and Security

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I. Executive Summary

This report summarizes the findings of an investigation conducted by the U.S. Department of Commerce (the "Department") pursuant to Section 232 of the Trade Expansion Act of 1962, as amended (hereinafter, the "statute" or "Section 232"), into the effect of imports of titanium sponge[1] on the national security of the United States.

[1] *See* Section IV, "Product Scope of the Investigation," for definition of titanium sponge.

Titanium sponge is the product of the application of various chemical processes on titanium ore, resulting in an end product called titanium sponge. Premium quality titanium sponge is used as the basis for titanium parts in many U.S. defense systems including military fighter aircraft and engines, satellite parts, naval and commercial ships, submarines, and military ground vehicles. Further, critical infrastructure applications such as petrochemical facilities, energy systems, water and sewer systems, and commercial aircraft and engines all depend on varying purities of titanium sponge.

The ore used to make titanium sponge is readily available worldwide. However, as of the date of this report, there is only one active large-scale industrial plant in the United States that produces titanium sponge. This facility is declining due to aging and damaged facilities and overall low global prices for titanium sponge. This facility only produced about [TEXT REDACTED] of U.S. consumption in 2018 and requires large-scale capital investment approaching [TEXT REDACTED] for continued operations. At full production, this facility would account for [TEXT REDACTED] of U.S. titanium sponge consumption in 2018, or approximately [TEXT REDACTED] per annum.

The United States imports 68 percent of the titanium sponge needed to fulfill domestic demand, largely from Japan, with smaller quantities coming from countries such as Kazakhstan and Ukraine. Some foreign producers, such as Russia's VSMPO-Avisma do not pass on the full cost of titanium sponge to downstream consumers and offer artificially low-priced finished titanium goods. This is most notable with VSMPO-Avisma's joint venture with Boeing to produce titanium-based aircraft parts in Russia for use in U.S.-assembled commercial aircraft.

China has a burgeoning capacity to manufacture titanium sponge. However, at present almost all of China's titanium sponge production is consumed by domestic demand. Nevertheless, Chinese producers are developing export markets for their downstream titanium products, and estimates indicate that at least 23 percent of all Chinese titanium mill products are exported. As Chinese producers develop their technical capabilities to include production of

aerospace-grade sponge suitable for use in rotating aircraft parts, China's impact on the global titanium sponge and downstream titanium markets may grow.

If no action is taken, it is anticipated that by [TEXT REDACTED] the U.S. may cease to have any domestic titanium sponge production capacity when the current U.S. facility reaches the end of its useful life. Despite national security concerns, for the reasons set forth in detail herein, an adjustment of tariffs on imported titanium sponge will not address the distortionary effect of non-market producers such as Russia, and eventually China, on the global titanium sponge market.

An alternative approach could include the United States government temporarily compensating U.S. industry for the difference between its comparatively higher production prices and lower global sale prices, affording U.S. industry time to make the investments required to reduce production costs to a level comparable with other market producers, and additional government stockpiles of U.S.-origin titanium sponge or U.S.-melted titanium in a stable form such as ingots. This report also examines the possibility for multilateral negotiations among the world's market titanium sponge producers to constructively address low prices, low inventory levels, and other factors that harm the U.S. and other market producers.

As required by the statute, the Secretary considered all factors set forth in Section 232(d). The Secretary examined the effect of imports on national security requirements, specifically:

i. domestic production needed for projected national defense requirements;

ii. the capacity of domestic industries to meet such requirements;

iii. existing and anticipated availabilities of the human resources, products, raw materials, and other supplies and services essential to the national defense;

iv. the requirements for growth of such industries and such supplies and services including the investment, exploration, and development necessary to assure such growth; and

v. the importation of goods in terms of their quantities, availabilities, character, and use as those affect such industries; and the capacity of the United States to meet national security requirements.

The Secretary also recognized the close relation of the economic welfare of the United States to its national security. Factors that can compromise the nation's economic welfare include, but are not limited to, the impact of "foreign competition on the economic welfare of individual domestic industries; and any substantial unemployment, decrease in revenues of government, loss of skills, or any other serious effects resulting from the displacement of any domestic products by excessive imports" (19 U.S.C. § 1862(d)). In particular, this report assesses whether titanium sponge is being imported "in such quantities" and "under such circumstances" as to "threaten to impair the national security."[2]

Findings

In conducting the investigation, the Secretary found:

A. Titanium Sponge is Essential to U.S. National Security

1. Titanium sponge is essential to the manufacturing and maintenance of U.S. defense systems. Titanium is used in many military applications, including aircraft frames, jet and helicopter engines, satellites, ships, submarines, and ground vehicles. Titanium sponge is the intermediate product resulting from the conversion of titanium ore into a form of titanium metal that can be melted to manufacture slab or ingot, which in turn is used to produce finished titanium products. Consequently, titanium sponge production is essential to the production and sustainment of many U.S. defense systems, and preserving this critical capability is imperative to the national security.
2. Further, Congress has implicitly recognized that titanium sponge is critical to national security by including titanium as a strategic material in the Specialty Metals Clause (10 U.S.C. § 2533b). The clause requires all titanium used in national defense systems to be melted or produced in the United States or a qualifying country. Additionally, the Department of the Interior included titanium on the 2018 List of Critical Minerals

[2] 19 U.S.C. § 1862(b)(3)(A).

required by Executive Order 13817 (December 20, 2017). The list established titanium as essential to the national security of the United States and found that the absence of a titanium supply would have significant consequences for the U.S. economy and the national security. An economically viable domestic source of titanium sponge, therefore, strengthens and diversifies the security of supply of U.S. semi-finished and finished titanium goods.

3. Titanium sponge is also vital for critical infrastructure. Titanium sponge, as the intermediate product for titanium metal, supports 15 of the 16 critical infrastructure sectors identified by the Department of Homeland Security (DHS).[3] Titanium sponge is used in products that support critical infrastructure sectors such as petrochemicals, energy systems, medical applications, transportation systems, water systems, commercial airframe and aircraft engines, and others.

B. The Continued Production of Titanium Sponge at the Sole Remaining Domestic Producer is Threatened

1. Though the U.S. was the first nation to commercialize titanium sponge production in the 1950s, U.S. domestic titanium sponge production capacity has declined significantly. In 1984, there were five plants producing titanium sponge in the U.S.; by 2019, only one producer capable of producing titanium sponge for defense, commercial, and industrial applications remained. U.S. titanium sponge producers had a combined capacity of [TEXT REDACTED] at two facilities in 2016,[4] but the idling of one of these facilities in late 2016 reduced available U.S. capacity to [TEXT REDACTED] in 2019.

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[3] U.S. White House. Office of the Press Secretary. *Critical Infrastructure Security and Resilience*. Presidential Policy Directive 21. (Washington, DC: 2013) https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil

[4] [TEXT REDACTED]

2. TIMET, the sole remaining U.S. titanium sponge producer, also has titanium melting operations. TIMET utilizes the entirety of its sponge production to satisfy internal demand for their titanium melt operations, which in turn manufactures semi-finished and finished titanium products for defense and critical infrastructure applications. The availability of economically viable titanium sponge production, therefore, is an essential component in TIMET's continued melt operations. It is important to note that TIMET's production of sponge does not fully cover needs for their internal melt operations, and TIMET imports about [TEXT REDACTED], on average, of its sponge needs each year.
3. [TEXT REDACTED] The disparity between TIMET's U.S. sponge production costs and non-U.S. sponge prices contributes to TIMET's increasing difficulty in determining whether the return on investment justifies continued sponge production.
4. TIMET, in addition to high production costs, must invest approximately [TEXT REDACTED] in its sponge facility by [TEXT REDACTED] in order to continue production due to "end of life" issues with portions of their integrated production process (including the crucial chlorination process). These essential, expensive capital investments, coupled with the availability of low-priced imports, have pressured TIMET to seriously consider closing its domestic sponge operations in favor of importing low priced non-U.S. sponge. The availability of low-priced sponge imports threatens the financial viability of the sole remaining large-scale sponge facility in the United States.

C. Low Priced Titanium Sponge Imports Threaten Continued U.S. Production and Contribute to the Weakening of the Internal Economy

1. The United States imports significant quantities of titanium sponge. Imports increased 13 percent from approximately 20,700 metric tons, or 59 percent of total consumption in the United States in 2010, to approximately 23,400 metric tons, or 68 percent of total

consumption in the United States in 2018.[5] The value of these imports averaged $196 million annually over the 2015 to 2018 period.

2. U.S. titanium sponge production and inventories satisfied just 32 percent of U.S. sponge demand in 2018, with the remainder of demand being filled by imports. Aggregate U.S. titanium sponge consumption exceeded production by [TEXT REDACTED], or [TEXT REDACTED], between 2015 and 2018. At most, U.S. production operating at full capacity could satisfy only [TEXT REDACTED] of U.S. demand for titanium sponge in 2018.
3. The vast majority of titanium sponge imports in 2018 came from Japan (94.4 percent), with smaller quantities from Kazakhstan (5.2 percent), and China, Russia, and Ukraine (each less than 1 percent).[6] Japanese imports increased from 75 percent of all imports in 2015, to 94.4 percent in 2018, an increase largely driven by the idling of one of the two remaining domestic sponge production facilities in 2016. Between 2015 and 2018, imports of Japanese titanium sponge increased by 43 percent as U.S. production decreased by 60 percent.[7] [8]
4. Allegheny Technologies Incorporated (ATI), a major U.S. titanium manufacturer, idled its titanium sponge operations in late 2016. ATI cited high costs of production and availability of low-priced imports as justification for idling its facility. [TEXT REDACTED]
5. TIMET is facing a similar situation as ATI did in 2016. TIMET must decide whether to continue to produce titanium sponge for their melting operations or import low-

[5] U.S. Geological Survey Minerals Report (2010-2018). Note that the U.S. Geological Survey statistics include Honeywell Electronic Materials' 500-metric-ton plant at Bountiful, Utah in its capacity figures. As this plant does not produce material that is used for industrial metal applications, it is excluded from this investigation. More information on this is provided in Chapters IV and V.

[6] USGS Minerals Yearbook 2018, Volume 1, Commodity Report

[7] USITC DataWeb, HTSUS Code 8108.20.0010, 2005 – 2018 Japanese Imports for consumption

[8] BIS Survey Data (U.S. Production)

priced sponge instead. As sponge import prices continue to drop, TIMET is having an increasingly difficult time justifying the continuation of its sponge production. [TEXT REDACTED] This issue is compounded by TIMET's need to recapitalize its sponge operation [TEXT REDACTED].

6. Declining global prices and higher imports of low-priced titanium sponge, principally from Japan, are the primary causes of the decline in U.S. titanium sponge capacity and production. The continued substitution of non-U.S. imports for U.S. produced sponge is the predominant factor in the domestic titanium sponge industry's decline.
7. Another factor impacting the health and competitiveness of U.S. sponge production is the growing use of titanium scrap. Advancements in melt technology have allowed titanium producers to use increasing amounts of titanium scrap, which is less expensive than titanium sponge, as a source of melt feedstock. Sponge demand and prices have therefore decreased due to increasing use of scrap. It is important to note that approximately 52 percent of scrap used in downstream U.S. titanium production is imported. The remaining 48 percent, which is domestically produced, is still dependent on non-U.S. titanium sponge imports for its initial production. Increasing usage of scrap in place of sponge and the consequent downward pressure on sponge prices places even further financial pressure on the remaining U.S. producer of titanium sponge.

D. Increased Foreign Sponge Capacity and Production Raise Future National Security Concerns

1. As U.S. titanium sponge production capacity has declined, other countries' capacities have increased. Between 2004 and 2018, Chinese titanium sponge production capacity increased approximately 1,050 percent from 9,500 metric tons to 110,000 metric tons.[9] Japanese capacity increased by 84 percent from 37,000 to 68,000 metric tons, and

[9] U.S. Geological Survey, "Titanium and Titanium Dioxide: 2006" and "Titanium and Titanium Dioxide: 2018"

Russian capacity increased by 66 percent from 28,000 tons to 46,500 metric tons.[10] By comparison, U.S. capacity stood at just [TEXT REDACTED] in 2018.

2. Although Chinese exports accounted for less than 1 percent of total U.S. imports of titanium sponge in 2018, China's dramatic growth in sponge production and capacity (38 percent of world capacity in 2018) is contributing to overall downward pressure on global titanium prices. The sole remaining domestic producer struggles to justify continued production due to availability of low-priced imports and the need for large capital expenditures. Any further decreases in global prices will put additional pressure on remaining U.S operations. This downward pressure may increase further as domestic Chinese demand for sponge is satisfied and China looks to export excess material of both sponge and finished titanium products.
3. Though China currently consumes almost all of its domestic production of titanium sponge, their large-scale capacity for mill products has allowed them to export approximately 23 percent of their titanium ingot and billet production. While no significant quantities of Chinese ingots or billets are imported into the U.S. at present, China has been exporting increasing quantities of commercial and industrial products containing titanium (bicycles, heat exchangers, condensers, automobile parts, structural aerospace parts, medical devices, construction materials, etc.). Increased Chinese exports of commercial and industrial products containing titanium (with a broader range than Russian exports of aerospace-focused titanium products), and a future focus on exports of titanium sponge, ingot, and billet is expected, as China has implemented a similar export strategy in other material markets. As the U.S. is the second largest market for titanium products in the world, the U.S. will be a natural target for low price imports from China.

[10] Ibid.

4. Only the United States, Japan, Russia, and Kazakhstan have titanium sponge plants certified to produce aerospace rotating-quality sponge that can be used for aerospace engine parts and other sensitive aerospace applications. While Chinese producers have not yet been certified in the U.S. to supply this type of aerospace-grade sponge, it is expected that they will develop the capability to do so in the near future. Increased Russian and future Chinese premium-quality sponge exported at non-market prices will harm the remaining U.S. and Japanese producers and may force U.S. commercial aircraft and engine manufacturers into dependence on Russian and Chinese sources.

Conclusion

Based on these findings, the Secretary concludes that the present quantities and circumstance of titanium sponge imports are "weakening our internal economy" and threaten to impair the national security as defined in Section 232. The consequent adverse impact on the domestic titanium sponge industry, along with the circumstance of increased global production and capacity in titanium sponge, especially in non-market economies, places the United States at risk of losing the remaining industrial capacity and technical knowledge essential to producing the titanium sponge needed to meet national defense and critical infrastructure requirements.

Imports of titanium sponge, which accounted for 68 percent of all sponge consumed in the United States in 2018, threaten to impair the national security by placing the remaining U.S. titanium sponge producer's operation under severe financial stress. Low-priced sponge imports, as well as low-priced titanium scrap imports, depress the price of U.S. titanium sponge and de-incentivize recapitalization of the remaining active facility's aging production capabilities. If the remaining facility ceases operation, the U.S. will have no active domestic capacity to produce titanium sponge for national defense and critical infrastructure needs.

Absent domestic titanium sponge production capacity, the U.S. will be completely dependent on imports of titanium sponge and scrap and will lack the surge capacity required to support defense and critical infrastructure needs in an extended national emergency.

Titanium producers, including producers of goods such as ingot, billet, sheet, coil, and tube, as well as end-users of finished titanium goods, are almost all entirely dependent on non-U.S. sources for sponge and scrap. This circumstance presents the possibility that, in a national emergency, U.S. titanium producers would be denied access to imports of titanium sponge and scrap due to supply disruption. If U.S. titanium producers do not have access to either domestic or imported supplies of sponge and scrap, their manufacturing operations would severely decline or cease once their existing titanium inventories are depleted. [TEXT REDACTED] The U.S. no longer maintains titanium sponge in the National Defense Stockpile.

Further, under current global market conditions and with the low price charged by non-market Russian and Chinese titanium producers, it is difficult for the remaining U.S. titanium sponge producer to justify the capital investments needed for continued operations. This inability to invest threatens continued operation of the sole domestic titanium sponge plant. If this capacity and associated skilled workforce are lost, it will be challenging and expensive to reconstitute U.S. titanium sponge production capabilities should the need arise.

The Department acknowledges that larger industry trends, including increased use of titanium scrap and downstream producers' emphasis on scrap recovery, have decreased the need for titanium sponge. These trends reflect U.S. titanium producers and end users' interest in maximizing profits by leveraging lower scrap costs and mitigating the need for new sponge purchases. However, these trends do not eliminate the need for new titanium sponge. Certain titanium parts, particularly those used in national defense systems, cannot be made using scrap and require new titanium sponge. Moreover, approximately 52 percent of all scrap is imported and subject to the same potential supply disruptions as sponge imports. The remaining 48

percent of scrap that is domestically produced is also subject to potential supply disruptions. The vast majority of this domestic scrap is generated from semi-fabricated and finished titanium product manufacturing operations, which at present rely on imported sponge for approximately 68 percent of their total sponge consumption.

The displacement of domestic titanium sponge by low-priced imports places the United States at risk of not being able to meet national security and critical infrastructure requirements during an emergency. The Secretary therefore finds that imports of titanium sponge threaten to impair the national security as defined in Section 232.

Recommendations

The Department has identified several potential actions that could be taken to address the threat of imports of titanium sponge to national security.[11] These actions include domestic initiatives and multilateral negotiations.

Option 1 - Domestic Initiatives

The Department has identified two possible domestic initiatives that the U.S government can undertake to stimulate reinvestment in domestic sponge production. These options include:

Option 1A – Voluntary Agreements with U.S. Titanium Sponge Producer(s) Under Title VII of the Defense Production Act of 1950

One of the challenges identified by the U.S. industry is that low prevailing market prices, which are driven by high volumes of low-priced imports, do not justify the capital investments required to sustain future production. To mitigate this situation, the U.S. government could temporarily compensate U.S. producer(s) for the difference between their current production costs and global purchase prices.

[11] The following recommendations are the Department's and do not necessarily reflect the recommendations of the other agencies with which the Department consulted during the course of this investigation.

Such compensation would serve as a temporary bridge until such time that U.S. producer(s) could make the capital investments needed to upgrade or build new production facilities, which will in turn lower production costs and safeguard future production. Although the proposed compensation is not likely to cover the full cost of any major capital investment, it would nevertheless encourage U.S. producers to invest their own funds in modernizing sponge production.

As shown in Figure A below, the Department estimates that providing this compensation over a five-year period would cost approximately [TEXT REDACTED] per year, or approximately [TEXT REDACTED] of titanium sponge produced. The Department bases these calculations on the remaining active U.S. producer of titanium sponge and assumes a five-year period would be required to make the essential capital investments needed to safeguard production. After completion of needed capital investments, U.S. production costs are expected to be competitive with the global sponge prices, and the compensation would no longer be required.

[TEXT REDACTED]		
	[TEXT REDACTED]	[TEXT REDACTED]
[TEXT REDACTED]	[TEXT REDACTED]	[TEXT REDACTED]
[TEXT REDACTED]	[TEXT REDACTED]	
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Option 1B - Expansion of the National Defense Stockpile to include titanium sponge and additional amounts of titanium metal

The USG also could address the threatened impairment by adding additional titanium materials to the National Defense Stockpile, while simultaneously encouraging the upgrade of domestic sponge production capacity by instituting long-term supply contracts for U.S. producers of titanium sponge and metal. To encourage domestic sponge production, the agreement for this additional material would specify that the winning bidder(s) agree to provide U.S.-origin titanium sponge and domestically melted semi-finished titanium products to fulfill the anticipated 15-year contract.

In order to safeguard against supply chain disruptions, the proposed National Defense Stockpile would maintain one year's worth of U.S. titanium sponge consumption needs (combined defense and commercial). Department survey data on U.S. producers and melters' 2018-2019 inventories, consumption, and costs were used to calculate and estimate needs for this proposed stockpile. In 2018, 34,100 metric tons of titanium sponge were consumed in the U.S. The sole domestic manufacturer of titanium sponge produced sponge at a cost of [TEXT REDACTED]. Additionally, [TEXT REDACTED] of titanium sponge was held by U.S. commercial producers in their inventories in 2018. In order to maintain one years' worth of U.S. consumption in the proposed stockpile (34,100 metric tons total), the USG would have to procure [TEXT REDACTED] of titanium sponge in order to supplement the 2018 commercial inventory level of [TEXT REDACTED]. The agreement would stipulate that commercial inventory levels cannot be sold or liquidated and must be maintained at 2018 levels.

A 15-year agreement to procure the total shortfall of [TEXT REDACTED] would require the purchase of roughly [TEXT REDACTED] of titanium sponge per year, at an average price of [TEXT REDACTED], for a cost of [TEXT REDACTED] per year. The 15-year agreement would result in the procurement of [TEXT REDACTED] of sponge for the stockpile maintained by the USG at a total cost of [TEXT REDACTED]. However, the final amount and mix of sponge and metal (titanium ingots and billets) to be added would be determined by the DoD in consultation with the Department and other agencies. Commercial inventories in the U.S.

(including inventories of non-U.S. suppliers) and other factors that could impact demand in a national emergency would be factored into the acquisition plan.

Option 2 - Multilateral Negotiations

As the Department observed in the recent steel, aluminum, and uranium Section 232 investigations, non-market actors can substantially distort the global market for products through price, quantity, and market access. For titanium sponge and downstream products, Russia and China are examples of such non-market actors. In 2018, Russian and Chinese titanium sponge producers controlled 61 percent of the world's titanium sponge production, an increase on their combined 55 percent share in 2008 and 37 percent share in 1998.

Non-market actors lower the price of titanium sponge, which causes financial harm to U.S. and other market producers, particularly Japan. Japanese producers have responded to low global prices by lowering their own sponge prices. Multilateral negotiations between the United States and other market producers of titanium sponge, including Japan and Kazakhstan, would present an opportunity to address issues affecting market titanium sponge production. The option below is budget neutral.

Option 2 – Common inventory of sponge for use among the parties to mitigate supply issues

In this option, the U.S. and other market titanium producers could agree to establish pre-positioned strategic stores of sponge for use by titanium sponge customers to be held at their U.S. titanium facilities or other locations in the United States. The amount of sponge held would vary with the annual amount sold to each particular customer commensurate to their market share. This action would mitigate potential shortfalls in sponge imports caused by a national emergency.

U.S. Titanium Industrial Base Analysis

The Department, in collaboration with the Department of Defense (DoD), the Department of Interior (DOI), and the U.S. Geological Survey (USGS), should survey and assess the

operating status and capacity of the U.S. titanium sponge and downstream titanium industries every three years. Such action would provide the USG with needed economic and financial data on this critical industrial base sector.

II. Legal Framework

A. Section 232 Requirements

Section 232 provides the Secretary with the authority to conduct investigations to determine the effect on the national security of the United States of imports of any article. It authorizes the Secretary to conduct an investigation if requested by the head of any department or agency, upon application of an interested party, or upon his own motion. *See* 19 U.S.C. § 1862(b)(1)(A).

Section 232 directs the Secretary to submit to the President a report with recommendations for "action or inaction under this section" and requires the Secretary to advise the President if any article "is being imported into the United States in such quantities or under such circumstances as to threaten to impair the national security." *See* 19 U.S.C. § 1862(b)(3)(A).

Section 232(d) directs the Secretary and the President to consider, in light of the requirements of national security and without excluding other relevant factors, the domestic production needed for projected national defense requirements and the capacity of the United States to meet national security requirements. *See* 19 U.S.C. § 1862(d).

Section 232(d) also directs the Secretary and the President to "recognize the close relation of the economic welfare of the Nation to our national security, and …take into consideration the impact of foreign competition on the economic welfare of individual domestic industries" by examining whether any substantial unemployment, decrease in revenues of government, loss of skills or investment, or other serious effects resulting from the displacement

of any domestic products by excessive imports, or other factors, results in a "weakening of our internal economy" that may impair the national security.[12] *See* 19 U.S.C. § 1862(d).

Once an investigation has been initiated, Section 232 mandates that the Secretary provide notice to the Secretary of Defense that such an investigation has been initiated. Section 232 also requires the Secretary to do the following:

(1) "Consult with the Secretary of Defense regarding the methodological and policy questions raised in [the] investigation;"

(2) "Seek information and advice from, and consult with, appropriate officers of the United States;" and

(3) "If it is appropriate and after reasonable notice, hold public hearings or otherwise afford interested parties an opportunity to present information and advice relevant to such investigation."[13] *See* 19 U.S.C. § 1862(b)(2)(A)(i)-(iii).

As detailed in the report, all of the requirements set forth above have been satisfied.

In conducting the investigation, Section 232 permits the Secretary to request that the Secretary of Defense provide an assessment of the defense requirements of the article that is the subject of the investigation. *See* 19 U.S.C. § 1862(b)(2)(B). Upon completion of a Section 232 investigation, the Secretary is required to submit a report to the President no later than 270 days after the date on which the investigation was initiated. *See* 19 U.S.C. § 1862(b)(3)(A). The report must:

(1) Set forth "the findings of such investigation with respect to the effect of the importation of such article in such quantities or under such circumstances upon the national security;"

(2) Set forth, "based on such findings, the recommendations of the Secretary for action or inaction under this section;" and

(3) "If the Secretary finds that such article is being imported into the United States in such quantities or under such circumstances as to threaten to

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[12] An investigation under Section 232 looks at whether imports threaten to impair the national security, rather than looking at unfair trade practices as in an antidumping investigation.

[13] Department regulations (i) set forth additional authority and specific procedures for such input from interested parties, *see* 15 C.F.R. §§ 705.7 and 705.8, and (ii) provide that the Secretary may vary or dispense with those procedures "in emergency situations, or when in the judgment of the Department, national security interests require it." *Id*., § 705.9.

impair the national security . . . so advise the President." *See* 19 U.S.C. § 1862(b)(3)(A).

All unclassified and non-proprietary portions of the report submitted by the Secretary to the President must be published. *See* 19 U.S.C. § 1862(b)(3)(B).

Within 90 days after receiving a report in which the Secretary finds that an article is being imported into the United States in such quantities or under such circumstances as to threaten to impair the national security, the President shall:

(1) "Determine whether the President concurs with the finding of the Secretary;" and

(2) "If the President concurs, determine the nature and duration of the action that, in the judgment of the President, must be taken to adjust the imports of the article and its derivatives so that such imports will not threaten to impair the national security" *See* 19 U.S.C. § 1862(c)(1)(A).

B. Discussion

While Section 232 does not specifically define "national security" both Section 232 and the implementing regulations at 15 C.F.R. Part 705 contain non-exclusive lists of factors that the Secretary must consider in evaluating the effect of imports on the national security. Congress in Section 232 explicitly determined that "national security" includes, but is not limited to, "national defense" requirements. *See* 19 U.S.C. § 1862(d).

The Department has determined that "national defense" includes both the defense of the United States directly and the U.S. "ability to project military capabilities globally."[14] The Department also concluded that "[i]n addition to the satisfaction of national defense requirements, the term 'national security' can be interpreted more broadly to include the general security and welfare of certain industries, beyond those necessary to satisfy national defense requirements, which are critical to the minimum operations of the economy and government."[15]

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[14] Department of Commerce, Bureau of Export Administration; *The Effect of Imports of Iron Ore and Semi-Finished Steel on the National Security*; Oct. 2001 ("2001 Report").

[15] *Id.*

The Department deemed these certain industries as "critical industries."[16] This report uses these interpretations of the terms "national defense" and "national security," as applying to "critical industries." In doing so, this report considers 16 critical infrastructure sectors identified in Presidential Policy Directive 21.[17]

Section 232 directs the Secretary to determine whether imports of any article are being made "in such quantities" or "under such circumstances" that those imports "threaten to impair the national security." *See* 19 U.S.C. § 1862(b)(3)(A). Accordingly, either the quantities or the circumstances, standing alone, may be sufficient to support an affirmative finding.

The statute does not prescribe a threshold or a standard for when "such quantities" of imports are sufficient to threaten to impair the national security, nor does it define the "circumstances" that might qualify.

Likewise, the statute does not require a finding that the quantities or circumstances are impairing the national security. Instead, the threshold question under Section 232 is whether those quantities or circumstances "threaten to impair the national security." *See* 19 U.S.C. § 1862(b)(3)(A). This makes evident that Section 232 may be used to prevent a threatened impairment to the national security from occurring before the national security is actually impaired.

Section 232(d) contains a list of factors for the Secretary to consider in determining if imports "threaten to impair the national security"[18] of the United States, and this list is mirrored in the implementing regulations. *See* 19 U.S.C. §1862(d) and 15 C.F.R. § 705.4. Congress was careful to note twice in Section 232(d) that the list provided, while mandatory, is not exclusive.[19]

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[16] *Id.*

[17] Presidential Policy Directive 21, *Critical Infrastructure Security and Resilience* (February 12, 2013) ("PPD-21").

[18] 19 U.S.C. § 1862(b)(3)(A).

[19] *See* 19 U.S.C. § 1862(d) ("the Secretary and the President shall, in light of the requirements of national security and without excluding other relevant factors…" and "serious effects resulting from the displacement of any domestic products by excessive imports shall be considered, without excluding other factors…").

Congress' illustrative list is focused on the ability of the United States to maintain the domestic capacity to provide the articles in question as needed to maintain the national security of the United States.[20] Congress broke the list of factors into two equal parts using two separate sentences. The first sentence focuses directly on "national defense" requirements, thus making clear that "national defense" is a subset of the broader term "national security." The second sentence focuses on the broader economy and expressly directs that the Secretary and the President "shall recognize the close relation of the economic welfare of the Nation to our national security."[21] *See* 19 U.S.C. § 1862(d).

In addition to "national defense" requirements, two of the factors listed in the second sentence of Section 232(d) are particularly relevant in this investigation. Both are directed at how "such quantities" of imports threaten to impair national security. *See* 19 U.S.C. § 1862(b)(3)(A). In administering Section 232, the Secretary and the President are required to "take into consideration the impact of foreign competition on the economic welfare of individual domestic industries" and any "serious effects resulting from the displacement of any domestic products by excessive imports" in "determining whether such weakening of our internal economy may impair the national security." *See* 19 U.S.C. § 1862(d). Imports of titanium sponge supplied 68 percent of U.S. consumption in 2018. Many of these imports are priced well

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[20] This reading is supported by Congressional findings in other statutes. *See, e.g.*, 15 U.S.C. § 271(a)(1) ("The future well-being of the United States economy depends on a strong manufacturing base…") and 50 U.S.C. § 4502(a) ("Congress finds that – (1) the security of the United States is dependent on the ability of the domestic industrial base to supply materials and services… (2)(C) to provide for the protection and restoration of domestic critical infrastructure operations under emergency conditions… (3)… the national defense preparedness effort of the United States government requires – (C) the development of domestic productive capacity to meet – (ii) unique technological requirements… (7) much of the industrial capacity that is relied upon by the United States Government for military production and other national defense purposes is deeply and directly influenced by – (A) the overall competitiveness of the industrial economy of the United States; and (B) the ability of industries in the United States, in general, to produce internationally competitive products and operate profitably while maintaining adequate research and development to preserve competitiveness with respect to military and civilian production; and (8) the inability of industries in the United States, especially smaller subcontractors and suppliers, to provide vital parts and components and other materials would impair the ability to sustain the Armed Forces of the United States in combat for longer than a short period.").

[21] *Accord* 50 U.S.C. § 4502(a).

below the prevailing price for U.S.-origin titanium sponge and have been a major factor in the decline of U.S. titanium sponge production.

Two other factors included in the statute that are also particularly relevant to this investigation are "loss of skills" and "loss of investment." *See* 19 U.S.C. § 1862(d). As imports of titanium sponge have increased, losses of U.S. titanium sponge production capacity have caused a decline in the skilled workforce needed for the sponge manufacturing process. These imports are also a disincentive for needed investment in aging U.S. titanium sponge production facilities; without this investment, future production of domestic titanium sponge is not sustainable. These factors are illustrative of a "weakening of the internal economy [that] may impair the national security" as defined in Section 232.

III. Investigation Process

A. Initiation of Investigation

On September 27, 2018 Titanium Metals Corporation (TIMET) petitioned the Secretary to conduct an investigation under Section 232 of the Trade Expansion Act of 1962, as amended (19 U.S.C. § 1862), to determine the effect of imports of titanium sponge on the national security.

Upon receipt of the petition, the Department reviewed the material facts outlined in the petition. Initial discussions were held with other bureaus within the Department as well as with the Department of Defense. Legal counsel at the Department also reviewed the petition to ensure it met the requirements of the Section 232 statute and the implementing regulations.

Subsequently, on March 4, 2019 the Department accepted the petition and initiated the investigation. Pursuant to Section 232(b)(1)(b), the Department notified the U.S. Department of Defense with a March 4, 2019 letter from Secretary Ross to Acting Secretary of Defense Patrick Shanahan (*See* Appendix A).

On March 8, 2019, the Department published a Federal Register Notice (*See* Appendix B - *Federal Register*, 84 FR 8503) announcing the initiation of an investigation to determine the

effect of imports of titanium sponge on the national security. The notice also announced the opening of the public comment period.

B. Public Comments

On March 8, 2019, the Department invited interested parties to submit written comments, opinions, data, information, or advice relevant to the criteria listed in Section 705.4 of the National Security Industrial Base Regulations (15 C.F.R. § 705.4) as they affect the requirements of national security, including the following:

(a) Quantity of the articles subject to the investigation and other circumstances related to the importation of such articles;

(b) Domestic production capacity needed for these articles to meet projected national defense requirements;

(c) The capacity of domestic industries to meet projected national defense requirements;

(d) Existing and anticipated availability of human resources, products, raw materials, production equipment, facilities, and other supplies and services essential to the national defense;

(e) Growth requirements of domestic industries needed to meet national defense requirements and the supplies and services including the investment, exploration and development necessary to assure such growth;

(f) The impact of foreign competition on the economic welfare of any domestic industry essential to our national security;

(g) The displacement of any domestic products causing substantial unemployment, decrease in the revenues of government, loss of investment or specialized skills and productive capacity, or other serious effects;

(h) Relevant factors that are causing or will cause a weakening of our national economy; and

(i) Any other relevant factors.

The initial public comment period ended on April 22, 2019.

The Department received 14 initial written submissions concerning this investigation, all of which were posted on Regulations.gov for public review. Parties who submitted comments included titanium industry participants, representatives of state and local governments, foreign governments, and other concerned parties.

All comments were then opened for a rebuttal period ending on May 22, 2019. Four rebuttal comments from titanium industry participants and other stakeholders were received and posted on Regulations.gov for public review.

All public comments were reviewed and factored into the investigative process. All public comments received are summarized in Appendix C, along with a link to the Regulations.gov docket (BIS-2018-0027) where comments can be viewed in full.

C. Information Gathering and Data Collection Activities

In order to gain insight into the U.S. titanium sponge industry, information gathering activities and meetings were held with representatives of domestic and international titanium sponge producers, titanium end users, industry associations, foreign governments, and other parties with an interest in the U.S. titanium sponge industry.

Due to the limited number of firms engaged in the U.S. titanium sponge industry, it was determined that a public hearing was not necessary in order to conduct a comprehensive investigation. In lieu of holding a public hearing on this investigation, the Department issued surveys (*See* Appendices D and E) to all participants in the U.S. titanium sponge industry as well as a representative sample of downstream consumers of titanium products. These surveys collected both qualitative and quantitative information. The first survey was designed for titanium sponge and semi-fabricated titanium product producers and was distributed to 10 organizations. The second survey was sent to 17 organizations, representative of downstream consumers of titanium products, including aerospace and other firms. The surveys provided an opportunity for organizations to disclose confidential and non-public information needed by the Department to conduct a thorough investigation.

These mandatory surveys were conducted pursuant to Section 705 of the Defense Production Act (DPA) of 1950, as amended (50 U.S.C. § 4555), and collected data on imports/exports, production, capacity utilization, employment, operating status, global competition, and financial information. The resulting aggregate data provided the Department

with detailed industry information that is otherwise not publicly available and was necessary to conduct analysis for this investigation.

Responses to the Department's questionnaires were mandatory (*See* 50 U.S.C. § 4555). Information furnished in the survey responses is deemed confidential and will not be published or disclosed except in accordance with Section 705 of the DPA. Section 705 of the DPA prohibits the publication or disclosure of this information unless the President determines that the withholding of such information is contrary to the interest of the national defense. Information will not be shared with any non-government entity other than in aggregate form.

D. Interagency Consultation

The Department consulted with the Department of Defense, including the Office of Industrial Policy and the Defense Logistics Agency, regarding methodological and policy questions that arose during the investigation.

The Department also consulted with other U.S. Government agencies with expertise and information regarding the domestic and global titanium sponge industries, including the Department's International Trade Administration, the Department of the Interior's U.S. Geological Survey, the Department of State, and the White House Office of Trade and Manufacturing Policy.

IV. Product Scope of the Investigation

The scope of this investigation defines titanium sponge at the Harmonized Tariff Schedule of the United States (HTS) 10-digit level. The product and its associated HTS code are provided in Figure 1 below.

Figure 1. Titanium Sponge Product Scope of the Investigation

Heading/Subheading/Product	10 Digit HTS Code
Titanium Sponge	8108.20.0010

Source: United States International Trade Commission and U.S. Department of Commerce, Bureau of Industry and Security

The HTS code includes all grades of titanium sponge, including standard grade and premium grade (aerospace non-rotating and aerospace rotating).[22] TIMET, the only operating U.S. titanium sponge facility, and Allegheny Technologies Incorporated (ATI), with an idled facility (2016), are the only two domestic companies with the capability and capacity to produce the types of titanium sponge included in the scope of this investigation. Though the HTS code also includes "ultra-high purity" titanium sponge, this type of sponge is not considered in the investigation. Ultra-high purity sponge is not used in conventional industrial titanium metal applications and is exclusively used for electronics manufacturing. Material from the one facility in the U.S. producing ultra-high purity sponge is not certified for aerospace applications.[23] Neither TIMET nor ATI have produced ultra-high purity sponge.

Titanium sponge is the necessary intermediate product between unprocessed titanium ore and titanium ingot and other downstream titanium products. For the purposes of this investigation, some downstream products including items such as titanium ingot and billet, titanium bar, titanium rod, titanium wire, titanium plate and sheet, and other titanium products, are examined in order to understand the titanium industry as a whole.

Another product examined is titanium scrap. Scrap is included because it can be used as a source of feedstock for titanium melting operations in addition to and in lieu of titanium sponge. U.S. melters are increasingly using both U.S. and non-U.S. origin scrap as feedstock for

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[22] Most titanium sponge is classified by its intended end use. Standard grade sponge is used for manufacturing and other routine industrial uses. Aerospace non-rotating grade sponge is used in static aerospace structural parts such as wing spars. Aerospace rotating grade sponge is used in high performance aerospace applications, such as engines and landing gear. Each of these grades has different chemistry and quality requirements established by end users.

[23] Honeywell Electronic Materials "Honeywell Sodium-Reduced Titanium Sponge" (2010). In the United States, this type of titanium sponge is manufactured by Honeywell Electronic Materials at a facility in Bountiful, Utah. [TEXT REDACTED]

their melting operations.[24] The titanium scrap that is produced and re-used in the U.S. is reliant on the availability of imported sponge for initial titanium production. Increased reliance on import-dependent titanium scrap, coupled with an increasing reliance on imported titanium sponge, highlights the growing concern that imports pose to both the titanium sponge producers as well as the U.S. downstream titanium industry.

The investigation also considers titanium consumption in aerospace and defense applications, including titanium parts used in airframe and engine assembly in addition to land and naval turbines. In addition, titanium use in critical infrastructure applications is included in overall consumption calculations.

V. Background on the U.S. Titanium Industry

The U.S. began producing titanium metal for industrial applications in the mid-20th century.[25] Titanium, which is principally found in ilmenite and rutile ores, is required for production of two broad types of titanium product. The largest market for titanium, accounting for 93 percent of global titanium feedstock consumption, is the production of titanium dioxide pigment, which is used in applications such as papers, paints, and plastics.[26] The second major market includes the production of titanium sponge for use in titanium metal semi-finished goods and titanium metal finished goods. Less than five percent of titanium feedstock is used in this market, which includes defense, commercial aerospace, and industrial end-use products.[27]

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[24] More information on scrap usage can be found in Chapter VII.

[25] Laurel G. Woodruff, George M. Bedinger, and Nadine M. Piatak, "Titanium: Chapter T of Critical Mineral Resources of the United States – Economic and Environmental Geology and Prospects for Future Supply". United States Geological Survey, Vienna, VA (2017), https://pubs.usgs.gov/pp/1802/t/pp1802t.pdf, T1.

[26] Ibid, T2.

[27] Ibid.

Titanium sponge is the source material needed to produce titanium metal products used in defense, commercial aerospace, and industrial applications. Titanium sponge is melted to produce titanium ingots, billets, and other downstream titanium goods and finished products such as titanium bar, titanium plate, titanium tube, titanium coil, and titanium sheet. It is important to note that titanium dioxide pigment and titanium sponge production are not interchangeable; titanium dioxide pigment cannot be converted into titanium sponge.

Though the U.S. is a significant global consumer and supplier of titanium products, there is only one remaining domestic producer capable of manufacturing titanium sponge for industrial and defense applications (*See* Figure 2). The other U.S. producer of titanium sponge, ATI, idled operations in late 2016. Honeywell Electronics Materials maintains limited capacity and capabilities to produce ultra-high purity titanium sponge at their facility in Utah, but the applications of this type of sponge are limited to specific electronic uses. Honeywell is not considered a source of titanium sponge production for defense and industrial applications.

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A. Titanium Sponge Manufacturing

The sponge production process must start with the conversion of titanium ore into a usable form. This is achieved through the blending of titanium feedstock, including rutile and ilmenite concentrates and titanium slag, with petroleum coke.[28] The concentrate/coke mixture is then exposed to chlorine in a fluid bed reactor at high temperatures. The resulting product is titanium tetrachloride ($TiCl_4$). TIMET manufactures $TiCl_4$ on-site at its Henderson facility for

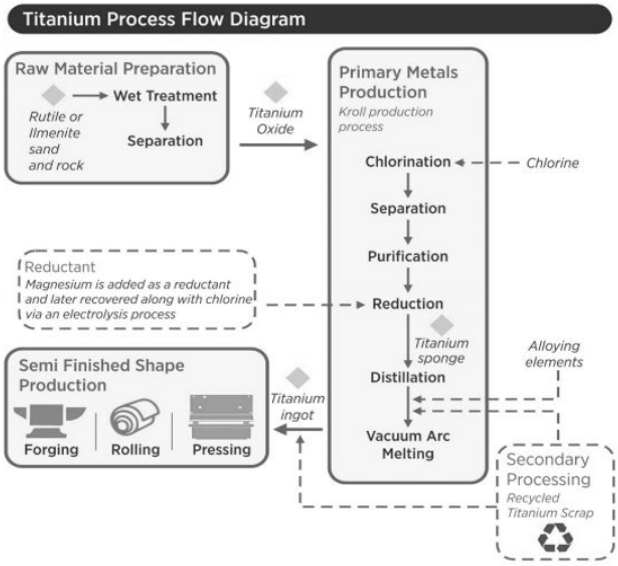
[28] Most $TiCl_4$ production in the United States is done using rutile ore and a certain variety of slag. TZ Minerals International Pty Ltd, "Titanium Feedstock Market Dynamics 2010: Outlook to 2018", 24.

use in sponge manufacturing.[29] Other U.S. producers of $TiCl_4$ include Chemours's facility in New Johnsonville, Tennessee and Cristal's facility in Ashtabula, Ohio.[30] However, the $TiCl_4$ produced by these firms is primarily used for titanium dioxide production for use in the pigments market. Once $TiCl_4$ has been produced or obtained, it can then be transformed into titanium sponge through two primary processes described below.

1. *Kroll Process*

The Kroll process, which was devised in the 1930s by chemist William Kroll and commercially deployed in 1948, is the principal method for producing titanium sponge. Currently all global producers of titanium sponge for aerospace and other industrial applications use the Kroll process. Figure 3 below shows the Kroll process in more detail.

Figure 3. – Kroll Process



Note: The above diagram shows sponge melted via the vacuum arc re-melting (VAR) process. VAR is not the only titanium melting process used in the United States. Cold-hearth melt processes, including electron beam and plasma melting, are also used.

Source: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "Bandwidth Study on Energy Use and Potential Energy Savings Opportunities in U.S. Titanium Manufacturing"

[29] U.S. production of rutile and ilmenite ore is limited; in 2018, U.S. production of these minerals accounted for just 5.7 percent of the world's combined rutile and ilmenite production. Petitioner obtains its rutile and ilmenite feedstock from Australia and South Africa. U.S. Geological Survey, "Titanium Mineral Concentrates" (2019), 177, https://prd-wret.s3-us-west-2.amazonaws.com/assets/palladium/production/atoms/files/mcs-2019-timin.pdf

[30] Ibid.

The Kroll process involves several steps. First, a pressurized steel vessel is filled with argon and magnesium enabling the reduction of $TiCl_4$.[31] The vessel is then heated to approximately 1,470 to 1,650 degrees Fahrenheit, and $TiCl_4$ is slowly introduced into the vessel.[32] The combined chemical and heat reaction causes the magnesium to react with the $TiCl_4$.[33] Two products are left following the reaction: titanium metal and magnesium chloride ($MgCl_2$). The $MgCl_2$ and any remaining unreacted magnesium are removed from the vessel, leaving only the titanium metal.[34] Due to its porous properties, the titanium metal produced in this process is colloquially known as titanium sponge. After production, the sponge is sheared and crushed into smaller pellets for storage and eventual melt.

2. Hunter Process

There have been limited attempts to develop alternatives to the Kroll process. The only current active commercial alternative to the Kroll process in the United States is the Hunter process, which is used at Honeywell Electronic Materials' plant in Bountiful, Utah.[35]

The Hunter process differs primarily in its use of sodium instead of magnesium during the production process. Use of sodium allows for the creation of a higher-purity sponge, albeit at a higher overall cost. Consequently, sponge produced by the Hunter process is almost exclusively used for manufacturing semiconductors.[36]

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[31] Steven J. Gerdemann, "Titanium Process Technologies", *Advanced Materials and Processes* (July 2001), https://www.asminternational.org/documents/10192/1755977/amp15907p041.pdf/292e9b8e-d88a-4a72-b67a-b1d8c7904baf, 41.

[32] Ibid.

[33] Ibid.

[34] Ibid.

[35] Honeywell Electronic Materials "Honeywell Sodium-Reduced Titanium Sponge" (2010)

[36] [TEXT REDACTED]

B. History of U.S. Titanium Sponge Production

Titanium sponge production in the United States began in 1938 with a demonstration of the Kroll process funded by the Bureau of Mines. During the Second World War, the U.S. government continued to fund research into the Kroll process and scalability for commercial production; a pilot production facility was completed in 1942.[37] Commercial production began in 1947 when E.I. du Pont de Nemours and Company (DuPont) opened a large scale production line. By 1952, DuPont's facility produced more than 800 metric tons of sponge per year.[38]

Increased aerospace industry demand for titanium encouraged entry into the titanium market. TIMET was founded in January 1950 as a joint venture by the National Lead Company and Allegheny Ludlum Steel Corporation.[39] TIMET opened a titanium sponge production line in Henderson, Nevada in 1951 which is still in service today. By 1957, U.S. titanium sponge production capacity stood at 33,100 metric tons per year, with an estimated actual production of 15,600 metric tons.[40]

U.S. government support was instrumental in setting up the domestic titanium sponge industry. After funding multiple sponge research projects, the General Services Administration (GSA) began a comprehensive investment program for commercial production. Beginning in August 1951, GSA advanced capital for the fixed investment costs in titanium sponge plant capacity as part of a contract to purchase a portion of plant output at specified prices or engaged in other contractual agreements. These arrangements were essentially government-backed

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[37] National Academy of Sciences – National Academy of Engineering, "Direct Reduction Processes for the Production of Titanium Metal", (March 1974), https://pdfs.semanticscholar.org/a101/06d88ae7 9a959156b3cfb6b45d2ad0372fe9.pdf, 5.

[38] F.H. Froes, ed., "Titanium – Physical Metallurgy, Processing, and Applications", (2015), https://www.asminternational.org/documents/10192/1849770/05448G_Sample.pdf/0cceaefd-da84-49d9-9ca4-1f95eb9fc304, 1.

[39] Ibid., 2.

[40] Ibid.; USGS, "Titanium Sponge Statistics" (January 19, 2017)

loans.[41] By the time the program ended in September 1955, it had resulted in contracts with five companies and created 21,000 tons of capacity.[42]

The United States was not alone in developing a titanium sponge industry. Imperial Chemicals Industries opened a titanium sponge production line in the United Kingdom in 1948. Japanese production began with Osaka Titanium Company in 1952, and, by 1954, five Japanese companies had opened titanium sponge production facilities with a combined capacity of 611 metric tons. The Soviet Union also opened three titanium sponge plants during the same period. These foreign competitors then began to challenge previous U.S. dominance of the titanium sponge industry. Sponge imports into the United States were first reported in 1956. By 1967, sponge imports accounted for one-third of all U.S. sponge consumption.[43]

Increased competition from foreign imports and fluctuating demand caused consolidations and closures of U.S. sponge manufacturers. In 1984, there were five plants producing titanium sponge totaling 30,400 metric tons of capacity.[44] By 1987, Teledyne Wah Chang in Albany, Oregon and Western Zirconium in Utah had closed their facilities, leaving a capacity of 25,400 metric tons.

These closures left three active sponge plants: TIMET's Henderson, Nevada facility, Oremet's Albany, Oregon plant, and a joint USX-National Distillers and Chemicals Corporation facility (later RTI International Metals, now Arconic) in Ashtabula, Ohio. Oremet's Albany plant was later sold to ATI and reactivated for a time in the 1990s and 2000s. RMI Titanium

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[41] U.S. Department of Justice, "Review of Voluntary Agreements Program Under the Defense Production Act: Titanium Metal Industry" (May 9, 1957), 11.

[42] Ibid.

[43] Ibid. In 1967, 81 percent of all U.S. imports came from the United Kingdom and Japan and the remaining 19 percent came from the Soviet Union. United States Tariff Commission, "Titanium Sponge from the U.S.S.R." (July 1968), 21.

[44] F.H. Froes, ed., "Titanium – Physical Metallurgy, Processing, and Applications", 3.

closed the Ashtabula facility in 1992[45], and ATI finally ended operations at the Albany plant in 2009 to coincide with the opening of their new Rowley, Utah facility.[46] During the same period, TIMET upgraded its operations at the Henderson plant to include a modern vacuum distillation plant, built with technology licensed from Toho Titanium Company.

In September 2007, to support its contracts with Airbus, RTI International Metals announced plans to build a 9,000 metric ton titanium sponge plant in Hamilton, Mississippi.[47] However, due to cost concerns and market conditions, the company cancelled construction of the plant in December 2009 and instead opted to sign new long-term supply agreements with Japanese producer Osaka Titanium Technologies Co. Ltd (OTC).[48]

ATI broke ground on a new titanium sponge plant in Rowley, Utah in 2006, with operations beginning at the facility at the end of 2009.[49] The Rowley facility did not have on-site $TiCl_4$ production capability and ATI had to source the material from other suppliers.[50] Reliance on external suppliers and increased production costs at Rowley, combined with decreasing global

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[45] Unlike its contemporaries, the Ashtabula plant used the Hunter process instead of the Kroll process. Paul C. Turner, Alan Hartman, et al. "Low Cost Titanium – Myth or Reality", U.S. Department of Energy, Office of Scientific and Technical Information (2001), https://www.osti.gov/servlets/purl/899609, 3.

[46] Frank Haflich, "ATI sponge plant closure seen a non-issue", *Fastmarkets AMM* (January 31, 2014), https://www.amm.com/Article/3304541/ATI-sponge-plant-closure-seen-a-non-issue.html

[47] Donna Ladd, "Breaking: RTI to Build Titanium Sponge Plant in Mississippi", *Jackson Free Press* (September 17, 2007), http://www.jacksonfreepress.com/news/2007/sep/17/breaking-rti-to-build-titanium-sponge-plant-in/

[48] Wally Northway, "RTI puts plant on hold indefinitely", *Mississippi Business Journal* (December 16, 2009), https://msbusiness.com/2009/12/rti-puts-plant-on-hold-indefinitely/

[49] "(AMM) ATI's Rowley titanium sponge plant launched", *Fastmarkets AMM* (January 15, 2010), https://www.metalbulletin.com/Article/2374249/AMM-ATIs-Rowley-titanium-sponge-plant-launched.html

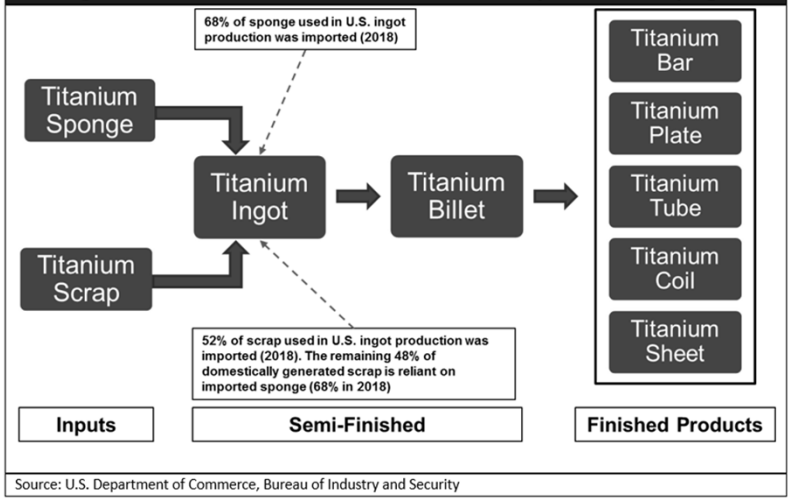
[50] ATI obtained $TiCl_4$ from a supplier in Ohio and shipped it via rail to the Rowley plant. The liability costs associated with shipping $TiCl_4$ were one of the factors contributing to ATI's decision to idle the plant. Allegheny Technologies Incorporated, "Comments on Section 232 National Security Investigation of Imports of Titanium Sponge", pp. 16-17.

titanium sponge prices, influenced ATI's decision to idle the plant in August 2016.[51] [TEXT REDACTED][52]

TIMET's Henderson facility has been the only operating U.S. titanium sponge production facility since 2017. [TEXT REDACTED][53] [TEXT REDACTED][54]

Understanding the role of titanium sponge in downstream titanium goods production is imperative to understanding the threat imports pose to the national security. Figure 4 outlines the general flow of inputs to outputs in the titanium products market and highlights the U.S. titanium industry's reliance on imports of titanium sponge and scrap.

Figure 4. Downstream Titanium Products and Reliance on Imported Titanium Sponge



Source: U.S. Department of Commerce, Bureau of Industry and Security

C. Titanium Melting and Finished Titanium Products

Once produced, titanium sponge must then be melted before it can be fabricated into ingot or slab suitable for downstream use.[55] In the United States, four companies have titanium melt

[51] Allegheny Technologies Incorporated, "Allegheny Technologies Announces Actions to Improve Future Financial Performance", (August 24, 2016), https://www.businesswire.com/news/home/20160824006136/en/Allegheny-Technologies-Announces-Actions-Improve-Future-Financial

[52] [TEXT REDACTED]

[53] [TEXT REDACTED]

[54] [TEXT REDACTED]

[55] Two processes are used for melting titanium: vacuum arc re-melting (VAR) and hearth melting. The VAR process involves placing the metal in a crucible in a vacuum-sealed furnace; the metal is melted using an electric

capacity: TIMET, Allegheny Technologies Incorporated (ATI), Arconic, and Perryman (*See* Figure 5).

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[TEXT REDACTED] These firms' capacity utilizations indicate overall company health. On average, the four firms' titanium melting operations had an average capacity utilization of 83 percent in 2018. Similarly, the firms' titanium milling operations had an average capacity utilization of 74 percent in 2018. High capacity utilization rates for melting and milling operations are attributable to strong demand for titanium products from the aerospace, medical, and petrochemical sectors.

Employment figures also suggest a healthy business outlook for the melters. [TEXT REDACTED] reported an average 21 percent increase in the number full-time employees between 2015 and 2019. [TEXT REDACTED] indicated a [TEXT REDACTED] decrease in full-time employees over the same period, this decrease can be attributed to [TEXT REDACTED].

Although the U.S. titanium melting industry is broadly healthy, it remains vulnerable to a potential national emergency. These melters, as will be discussed in Chapter VII, are dependent on non-U.S. sources for much of their titanium sponge and titanium scrap feedstock. If these

arc and then formed into an ingot. The hearth melting process uses electron or plasma beams to melt the sponge in a water-cooled hearth; the melted material then forms an ingot.

sources are lost, U.S. titanium melters would be unable to supply vital national defense and critical infrastructure applications.

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Four notable U.S. firms use titanium in their finished products: [TEXT REDACTED] Further information on their titanium usage are outlined below in Figures 10 through 13.

These four end-user companies provide a snapshot of the types of finished titanium products that U.S. companies manufactured in 2018, as well as the sectors that these finished products supported. Both commercial and defense sectors are supported by these companies, and some exported a significant portion of their commercial titanium products. These exports highlight the demand for U.S.-produced titanium products and stress the health of this particular part of the U.S. titanium supply chain.

Despite the health of these companies, it is important to note that the four titanium melters which supply titanium goods to these end users are reliant on imports of titanium sponge and scrap for production. End users are therefore indirectly subjected to the same potential risks as their titanium suppliers. The inter-dependency between these companies emphasizes the

entirety of the U.S. titanium supply chain's dependency on imports of titanium sponge and scrap and vulnerability to the associated national security threat.

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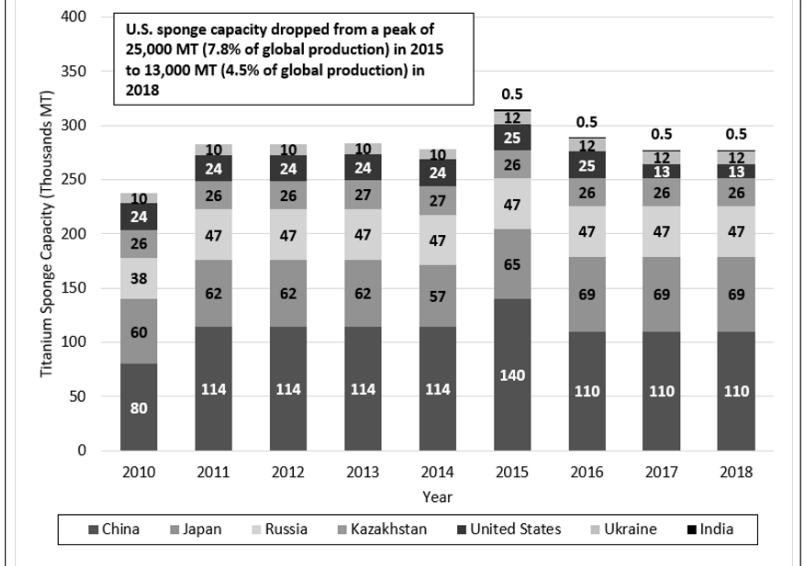
VI. Global Titanium Sponge Industry Conditions

A. Overview

Only a few countries possess the capability to manufacture titanium sponge due to the significant capital investment and supporting infrastructure required to maintain and operate facilities. Figure 14 below identifies countries with titanium sponge production capacity. Over the 2010-2018 period, countries such as China, Japan, and Russia saw capacity growth rates between 15 and 38 percent; in contrast, the U.S. experienced a 46 percent decline. The sole operating U.S. facility has [TEXT REDACTED] of capacity, which is among the smallest worldwide.[56]

Figure 14. World Titanium Sponge Capacity, 2010 - 2018



Note: U.S. capacity figures include Honeywell's sponge operations

Source: U.S. Geological Survey

[56] The figure provided on this graph includes Honeywell Electronic Materials' 500 MT facility which produces ultra-high purity sponge for use in electronic applications. This type of sponge is not considered in the investigation. [TEXT REDACTED]

Many of the major non-U.S. producers of titanium sponge opened their facilities in the immediate post WWII period to fulfill burgeoning aerospace demand. Plants in Russia (now VSMPO-Avisma) and Kazakhstan (now UKTMP), which were commissioned in the 1950s and 1960s to serve Soviet military aerospace demand, are examples of these. Since the collapse of the Soviet Union, VSMPO-Avisma and UKTMP have shifted their focus towards civilian applications. VSMPO-Avisma, as will be detailed in Chapter VII, has built extensive supplier relationships with Boeing, Airbus, and other Western aerospace firms. UKTMP has pursued similar relationships with aerospace firms and has also entered into joint ventures with Korean and French firms to expand its ingot and slab manufacturing capabilities.

Although VSMPO-Avisma and UKTMP have diversified their product offerings, the two companies remain prominent global producers of sponge. During the 2015-2018 period, both VSMPO-Avisma's and UKTMP's production levels remained constant at 26,000 metric tons and 47,000 metric tons respectively. Combined, these firms account for approximately 25 percent of global production.

China, India, and Saudi Arabia are more recent entries into the global market. China's sponge production capacity, which stood at 7,000 metric tons in 1998, increased by nearly 1,500 percent to 110,000 metric tons in 2018.[57] This increase in capacity has not yet resulted in an increased supply of Chinese sponge on the global market, as Chinese production is principally for domestic consumption at this time. However, China is expected to participate in the global titanium sponge market in the coming years once domestic needs are satisfied. Chinese titanium sponge development, as will be described in a subsequent section, is a key part of Chinese government initiatives to develop the country's defense industrial base, particularly the

[57] U.S. Geological Survey, Titanium and Titanium Dioxide (1999), https://s3-us-west-2.amazonaws.com/prd-wret/assets/palladium/production/mineral-pubs/titanium/670399.pdf

aerospace sector. Japanese and other titanium sponge producers have limited to no access to the Chinese market for sponge.

India's sponge plant, which has a capacity of 500 metric tons and came online in 2015, was built to address titanium needs for the country's space program and is not yet intended for commercial production. In contrast, Saudi Arabia's plant is part of the country's economic diversification strategy. Owned by a joint venture of Saudi firms Tasnee and Cristal and Japanese sponge producer Toho, the Saudi plant's 15,600 metric ton capacity rivals existing plants in the United States, Ukraine, Russia, and Japan and began operations in September 2019.[58]

Several factors have driven new entries into the titanium sponge market and expansions of existing capacity. One of these is significant commercial aircraft production backlogs at Boeing and Airbus. As of June 2019, Boeing had an estimated seven year backlog of 5,733 aircraft and Airbus reported an estimated nine year backlog of 7,276 aircraft.[59] Meeting these orders will require increased production of titanium parts, which will require increased production of titanium sponge. Growth in shipbuilding, particularly in China and the Republic of Korea, is also driving demand for titanium.[60] Titanium has growing maritime applications, including in marine turbines, propeller shafts, and various exhaust and piping systems. Expansions in global petrochemical and power generation industries are also raising demand for titanium parts.[61]

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[58] "Tasnee postpones its titanium sponge project to H2 2019", *Argaam,* (June 25, 2019), https://www.argaam.com/en/article/articledetail/id/615205

[59] J. Kasper Oestergaard, "Airbus and Boeing Report June 2019 Commercial Aircraft Orders and Deliveries"< Defense and Security Monitor – Forecast International" (July 16, 2019), https://dsm.forecastinternational.com/wordpress/2019/03/15/airbus-and-boeing-report-february-commercial-aircraft-orders-and-deliveries/

[60] Argus Metals, "Feed shortage hampers world Ti sponge ramp up," (May 16, 2019), https://metals.argusmedia.com/newsandanalysis/article/1904225

[61] Ibid.

Production follows a similar pattern of non-U.S. increases and U.S. decreases. As shown in Figure 15 below, Chinese, Russian, and Japanese production levels increased between 21 and 63 percent over the 2010 to 2018 period. Although U.S. production data before 2015 is unavailable, U.S. production decreased [TEXT REDACTED] between 2015 and 2018.

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B. Prior Trade Investigations

The United States Government has examined previous allegations of dumping and subsidies for the titanium sponge industry (*See* Figure 16). A review of these cases can be found in Appendix F.

Figure 16. Trade Investigations of Titanium Sponge, 1968 - 2017

Country	Date	Determination	Action
Union of Soviet Socialist Republics	April 1968	Affirmative	Antidumping duty order issued on imports from the U.S.S.R.
United Kingdom and Japan	January 1984	Affirmative for Japan, Negative for the U.K.	Antidumping duty order issued on imports from Japan
Japan, Kazakhstan, Russia, and Ukraine	August 1998	Negative	Antidumping duty orders on Japan, Kazakhstan, Russia, and Ukraine revoked
Japan and Kazakhstan	November 2017	Negative	No indication of injury to domestic industry from Japanese or Kazakhstani sponge imports

Source: U.S. International Trade Commission

C. U.S. Duties on Titanium Sponge Imports

As of November 2019, all titanium sponge imported into the United States is subject to a 15 percent duty rate.[62] However, U.S. firms importing titanium sponge generally do not pay this rate due to the drawback provisions of 19 C.F.R. Part 191. Under 19 C.F.R. Part 191, manufacturers are able to claim drawback:

> "upon the exportation [of articles]…which are not used in the United States prior to their exportation or destruction, and which are manufactured or produced in the United States, wholly or in part with the use of particular imported, duty-paid merchandise and/or drawback products."[63]

In other words, a titanium manufacturer that imports sponge and then uses it to manufacture an ingot or other downstream titanium product that is exported to another country can claim drawback on the 15 percent duty paid on the sponge. Titanium manufacturers also benefit from the provision of 19 C.F.R. Part 191 that allows for a degree of substitution between industrial inputs. U.S. manufacturers have agreements with U.S. Customs and Border Protection that permit them to substitute scrap for sponge in drawback claims, thus allowing them to reclaim some of the duty paid without having to use the physical sponge associated with that duty amount.[64]

Some titanium producers have argued that the existing tariff harms the U.S. industry's overall competitiveness. As all producers other than TIMET are 100 percent dependent on imported sponge, U.S. producers must pursue the drawback process to recover the duty paid. In

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[62] Harmonized Tariff Schedule of the United States (2019) Revision 14, Chapter 81, Metals, Cermets, Articles Thereof, 8108.20.0010.

[63] U.S. Code of Federal Regulations Title 19, Part 191.21

[64] Until 2018, titanium manufacturers could reclaim up to 99 percent of the duty paid through the drawback process. In 2015, the Trade Facilitation and Trade Enforcement Act (TFTEA) introduced a "lesser of" provision that calculates the drawback amount based on the "lesser of" a) the value of duties, taxes, and fees paid on the imported material or b) the value of duties, taxes, and fees that would have been paid on the substitute material if it had been imported. TIMET calculates that this will cap drawback recovery at approximately 66 percent of total duty paid for most manufacturers. U.S. Customs and Border Protection and the Treasury Department, "Modernized Drawback: A Proposed Rule", *Federal Register* vol. 83, 37886-37990. https://www.federalregister.gov/documents/2018/08/02/2018-16279/modernized-drawback and Titanium Metals Corporation, Petition for Relief under Section 232, Exhibit 16.

contrast, certain downstream goods made with significant quantities of titanium, including aircraft parts, can be imported into the United States duty-free.[65]

VII. Findings

A. Titanium Sponge is Essential to U.S. National Security

As discussed in Chapter II, "national security" under Section 232 includes both national defense requirements and critical infrastructure applications.

The vast majority of titanium sponge is used to satisfy civilian aerospace and other industrial applications (*See* Figure 17).

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1. Titanium Sponge is Required for National Defense Systems

Titanium metal, and, by extension, titanium sponge, is a critical material for many U.S. defense systems.[66] As a lightweight and durable material, titanium has been incorporated into U.S. military aircraft, including fighter jets, bombers, attack aircraft, transports, and helicopters.

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[65] Harmonized Tariff Schedule of the United States (2019) Revision 14, Chapter 88, Aircraft, Spacecraft, and Parts Thereof

[66] The distinction between metal and sponge is made because sponge is an intermediate product. Titanium sponge is one of several sources of potential feedstock for titanium metal, including scrap titanium and titanium slag.

Newer aircraft use increased amounts of titanium compared to earlier generations of aircraft, as illustrated in Figure 18.

Figure 18. Titanium Content in Select U.S. Military Airframes		
Airframe	**Introduction into Service**	**% of Titanium Content**
CH-47 Chinook	1962	8%
F-15 Eagle	1976	10%
F-16 Fighting Falcon	1978	7%
F/A-18 Hornet	1984	12%
F-22 Raptor	2005	39%
V-22 Osprey	2007	31%
F-35 Lightning II	2015	20%
Military airframes entering service after 2000 have an average **30 percent** titanium content; airframes entering service prior to 2000 had an average of just **9 percent**.		
Source: Arconic Engineered Structures, "World Titanium Trends in Defense", Presentation at the Titanium USA conference, September 24, 2019		

Titanium is also used for ground vehicle armor and frames, as well as naval vessel components. A brief listing of U.S. defense systems using titanium metal can be found in Appendix G.

Congress has recognized the defense importance of titanium metal, including titanium sponge, through legislation. In 1973, Congress expanded the Berry Amendment (10 U.S.C. § 2533a) to include what it defined as "specialty metals."[67] This addition, commonly known as the "Specialty Metals Clause," requires that certain metals procured by DoD for defense use must be melted or produced in the United States or a qualifying country.[68] Both titanium and titanium

[67] The Fiscal Year 2007 National Defense Authorization Act removed this requirement from the Berry Amendment and separately established it in 10 U.S.C. § 2533b. Valerie Bailey Grasso, "The Specialty Metal Clause: Oversight Issue sand Opinions for Congress", *Congressional Research Service* (February 6, 2014), 1.

[68] As defined by DFAR 252.225-7001, qualifying countries are defined as those countries which have reciprocal defense procurement memorandums of understanding or other similar international agreements with the United States. These countries include Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Israel, Italy, Japan, Latvia, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom.

alloys are covered by the Specialty Metals Clause.[69] Although the clause does not require that titanium sponge be of U.S. origin, the domestic melt requirement conveys a Congressional recognition of domestic titanium's overall importance to U.S. defense objectives and the criticality of titanium sponge to defense needs.

Though titanium is a key component of many defense systems, defense requirements are a small fraction of overall titanium demand. Consequently, U.S. titanium sponge production depends on the industry's commercial viability and continued ability to supply civilian needs for titanium metal.

While the United States does not currently maintain a stockpile of titanium sponge, a stockpile was maintained for over 50 years. Beginning in 1954, the Defense National Stockpile Center (DNSC) maintained a substantial stockpile of titanium sponge pursuant to the Strategic and Critical Minerals Stockpiling Act. The DNSC initially envisioned that the stockpile would be of sufficient size to supply peak consumption by downstream industry for up to one year. The exact yearly figure has not been publicly released, however, it was estimated to include up to 25,964 short tons (23,554 MT) of stockpile grade in 1994.[70] Following the end of the Cold War, Congress determined that the stockpile was no longer required and authorized its disposal in 1997; all material was sold off by 2005.[71]

2. Titanium Sponge is Required for Critical Infrastructure

Titanium sponge is also required to satisfy U.S. critical infrastructure needs. As noted earlier, U.S. civilian industries consume roughly [TEXT REDACTED] of all titanium sponge

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[69] Ibid.

[70] DNSC distinguished between stockpile grade and non-stockpile grade titanium sponge. In 1994, for example, the DNSC stockpile included 25,964 short tons of stockpile grade sponge and 10,866 short tons of non-stockpile grade sponge. U.S. Geological Survey, "Minerals Yearbook: Titanium" (1994), 1. https://s3-us-west-2.amazonaws.com/prd-wret/assets/palladium/production/mineral-pubs/titanium/670494.pdf

[71] Seong, Younoussi and Goldsmith, "Titanium: Industrial Base, Price Trends, and Technology Initiatives", 38.

produced each year. The Department's definition of critical infrastructure follows the sectors identified in Presidential Policy Directive 21 (PPD-21) (*See* Figure 19).[72]

Figure 19. U.S. Critical Infrastructure Sectors - 16			
Chemical	Commercial Facilities	Communications	Critical Manufacturing
Dams	Defense Industrial Base	Emergency Services	Energy
Financial Services	Food and Agriculture	Government Facilities	Information Technology
Nuclear Reactors, Waste, and Materials	Transportation Systems	Water and Wastewater Systems	Healthcare and Public Health
Source: Presidential Policy Directive 21, February 21, 2013			

Of these 16 sectors, titanium sponge most regularly supports the Transportation Systems sector. This sector includes commercial passenger and cargo aviation and related aircraft engines, which carried approximately 841 million passengers[73] and 27.8 million revenue tons of cargo[74] in 2018. Almost all modern passenger and cargo aircraft and related engines contain significant amounts of titanium. For example, a completed Boeing 787 Dreamliner requires approximately 24.9 metric tons of titanium for its manufacture;[75] and the similarly sized Airbus A350 requires approximately 27.4 metric tons of titanium.[76] Passenger aircraft manufacturers are using increasing amounts of titanium due to titanium's unique properties.

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[72] PPD-21 was also used in the Department's 2018 Section 232 investigations on steel and aluminum, as well as the 2019 investigation on uranium. The White House, Office of the Press Secretary, "Presidential Policy Directive – Critical Infrastructure Security and Resilience", (February 12, 2013), https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil

[73] U.S. Department of Transportation, Bureau of Transportation Statistics, "Table 1B. 2018 Passengers on U.S. and Foreign Airlines by Origin and Destination", https://www.bts.gov/table-1b-2018-passengers-us-and-foreign-airlines-origin-and-destination

[74] U.S. Department of Transportation, Bureau of Transportation Statistics, "Air Cargo Summary Data October 2002 – February 2019)", https://www.transtats.bts.gov/freight.asp?pn=0&display=data2

[75] Alwyn Scott, "Boeing looks at pricey titanium bid to stem 787 losses", *Reuters* (July 24, 2015), https://www.reuters.com/article/us-boeing-787-titanium-insight-idUSKCN0PY1PL20150724

[76] AZO Materials, "The A350 XWB – Advanced Materials and Design", (November 26, 2012), https://www.azom.com/article.aspx?ArticleID=7858

Although the aerospace sector is the largest single consumer of titanium, other sectors also require titanium. The U.S. Geological Survey estimates that approximately 20 percent of titanium sponge or 19,000 metric tons per year, is used for non-aerospace applications.[77] Oil, gas, and other petrochemical industries and nuclear reactors typically use titanium for heat exchangers, pressure vessels and piping systems. Titanium is used due to its corrosion resistance and endurance for high pressure, high temperature uses. These properties also make titanium a suitable material for use in power generation applications. Many modern electrical turbines include titanium components.

Titanium is also used for medical applications, including surgical instruments, replacement joints, dental implants, wheelchairs, and other apparatuses. Titanium is highly biocompatible; it can be implanted in the human body without causing a reaction or rejection.[78] Eight of the 10 producers and melters survey respondents reported manufacturing titanium products used in various critical infrastructure applications. Eight of the ten producers and melters survey respondents supported the Transportation Systems sector through manufacture of airplanes and aerospace components. The top 5 sectors, not including the defense industrial base sector, supported by the 10 survey respondents are represented in Figure 20.

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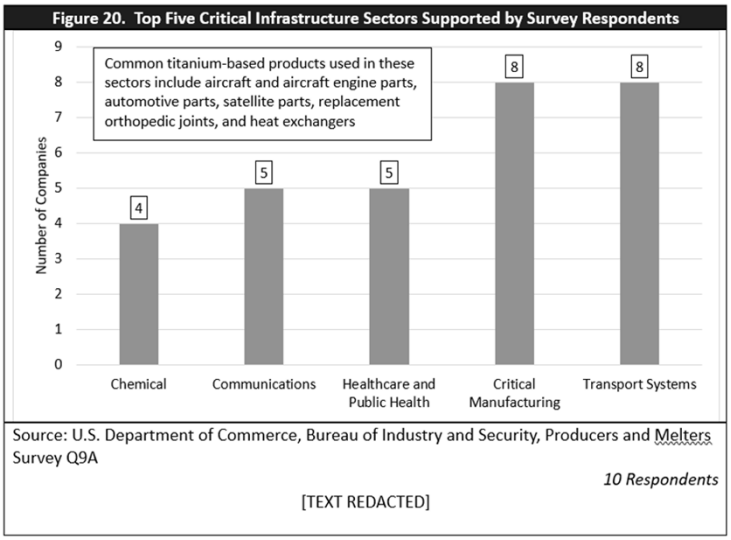
[77] U.S. Geological Survey, "Titanium and Titanium Dioxide: 2019", https://prd-wret.s3-us-west-2.amazonaws.com/assets/palladium/production/atoms/files/mcs-2019-titan.pdf, 174.

[78] C.N. Elias, J.H.C. Lima, R. Valiev and M.A. Meyers, "Biomedical Applications of Titanium and its Alloys", *JOM*, (March 2008), http://meyersgroup.ucsd.edu/papers/journals/Meyers%20316.pdf, 46.



3. Titanium Is Considered a Critical Mineral

Titanium is one of the 35 minerals included by DOI on the Critical Minerals List. This list, which President Trump directed DOI to define in Executive Order 13817 of December 20, 2017, includes minerals which meet the following criteria:

(i) A non-fuel mineral or mineral material essential to the economic and national security of the United States,

(ii) the supply chain of which is vulnerable to disruption, and

(iii) that serves an essential function in the manufacturing of a product, the absence of which would have significant consequences for our economy or our national security.[79]

USGS observed that titanium has significant uses for aerospace, defense, energy, and telecommunications; these sectors are representative of industries critical to U.S. economic and national security.[80] For this reason among others as well as based on input from other U.S. government agencies, USGS included titanium on the critical minerals list.

[79] White House, "Presidential Executive Order on a Federal Strategy to Ensure Secure and Reliable Supplies of Critical Materials", (December 20, 2017), https://www.whitehouse.gov/presidential-actions/presidential-executive-order-federal-strategy-ensure-secure-reliable-supplies-critical-minerals/

[80] U.S. Geological Survey, "Draft Critical Mineral List – Summary of Methodology and Background Information – U.S. Geological Survey Technical Input Document in Response to Secretarial Order No. 3359" (2018), https://pubs.usgs.gov/of/2018/1021/ofr20181021.pdf, 2.

Although titanium sponge is not separately mentioned, USGS's methodology implies a recognition that titanium sponge is just as critical as titanium:

> Potential supply chain vulnerabilities relating to critical minerals extend beyond what is described herein and should be considered as part of the strategy within the report to the President required by the EO. For example, enhancing domestic mineral processing capacity is important to prevent the immediate export of domestically mined ore.[81]

By extension, the U.S. downstream industry's reliance on titanium sponge imports can be considered a supply chain vulnerability. USGS assesses the United States as having a "moderate import reliance on titanium metal (sponge)," while also noting that the U.S. is a significant exporter of finished titanium products.[82] As titanium sponge is required for the manufacture of downstream titanium goods, limited sponge production capacity can create a supply bottleneck. Such a bottleneck is one of the "vulnerabilities" identified in Executive Order 13817.[83]

B. The Economic Decline of the U.S. Titanium Sponge Industry Is Caused by Increased Imports of Titanium Sponge

1. U.S. Reliance on Imports of Titanium Sponge Is Increasing

The United States possesses one third of the world's titanium melt capacity and one quarter of its titanium milling capacity, which results in a substantial demand for inputs including titanium sponge.[84] Because only [TEXT REDACTED] of 2018 domestic demand can be filled by domestic production, U.S. companies are heavily reliant on imports of titanium sponge. Imports accounted for 68 percent of all titanium sponge consumed in the United States

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[81] Ibid.

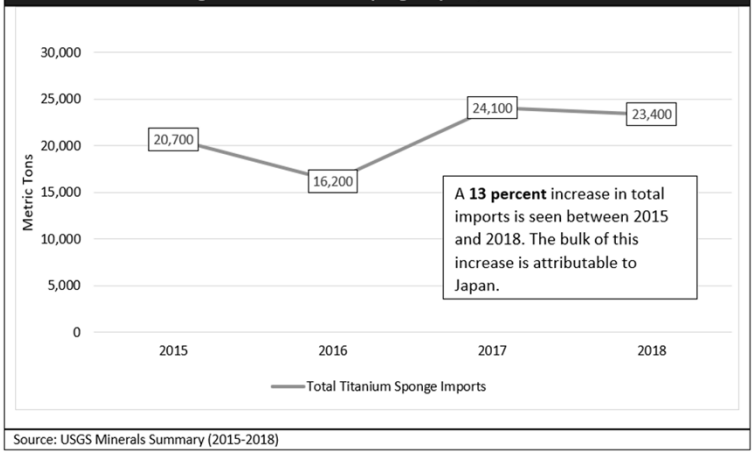
[82] Although USGS distinguishes between import reliance and import vulnerability (e.g., reliance on imports from countries with 'governance risks'), this distinction is not relevant for the present Section 232 investigation. The Section 232 statute discusses imports in broad terms and does not distinguish among importers based on perceived political risk.

[83] White House, "Presidential Executive Order on a Federal Strategy to Ensure Secure and Reliable Supplies of Critical Materials".

[84] Roskill, "Titanium Metal: Global Industry, Markets, and Outlook 2018 – 8th Edition"

in 2018. This reliance on imports of titanium sponge increased by more than 13 percent between 2015 and 2018 (*See* Figure 21).

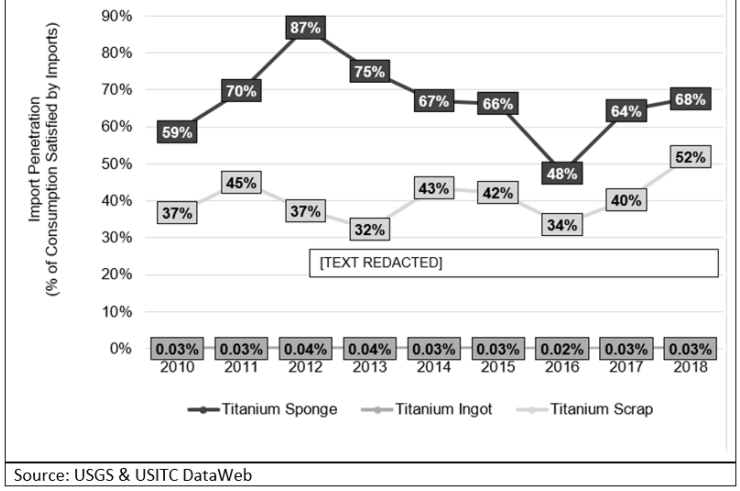
Figure 21. U.S. Titanium Sponge Imports, 2015 - 2018



Source: USGS Minerals Summary (2015-2018)

Over the 2010 to 2018 period, both titanium sponge import penetration and titanium scrap import penetration have grown (*See* Figure 22). Though titanium ingot import penetration remains low over the period, ingot production is reliant on both titanium sponge and scrap as feedstock. Increasing reliance on non-U.S. sponge and scrap to meet ingot production needs indicates the threat imports pose to the titanium industry as a whole.

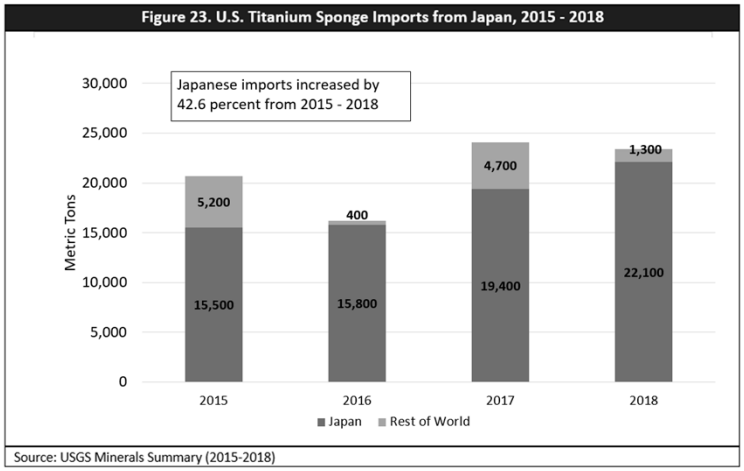
Figure 22. Titanium Sponge Import Penetration, 2010 - 2018



Source: USGS & USITC DataWeb

Of the titanium sponge imported in 2018, 94.4 percent came from Japanese producers, 5.2 percent came from Kazakhstan, and the remaining amount (less than 1 percent) was sourced

from Russia and Ukraine, among other countries.[85] Japanese imports of titanium sponge increased from 75 percent of all imports in 2015 to over 94 percent by 2018 (*See* Figure 23). [TEXT REDACTED] [86]

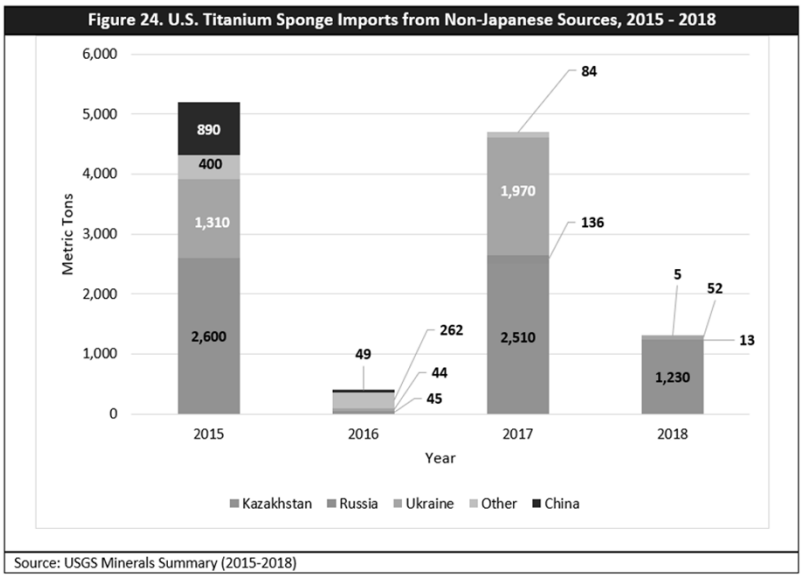


As imports of Japanese sponge increased between 2015 and 2018, imports of sponge from non-Japanese sources declined by approximately 75 percent in the same period (*See* Figure 24). In Russia and Kazakhstan, decreased sponge exports trend with their producers' preference for selling higher volume, less price-sensitive finished downstream titanium products.[87] Imports of Chinese titanium sponge also declined due to increased internal demand from their domestic titanium industry.

[85] USGS Minerals Yearbook, 2018

[86] [TEXT REDACTED]

[87] VSMPO-Tirus, the exclusive U.S. distributor for VSMPO-Avisma, does not advertise sponge as a product for sale. https://www.vsmpo-tirus.com/products/ In recent years, Kazakh producer UKTMP has also shifted its focus towards sale of milled products through its joint ventures with Korean producer Posco and French producer Aubert et Duval.



U.S. reliance on imported titanium sponge is even clearer when compared to total U.S. consumption of sponge. Figure 25 indicates that demand for sponge continued to increase as U.S. production decreased. Although U.S. consumers of sponge are currently able to meet their needs through imported sponge, decreasing U.S. production and rising U.S. demand illustrate the potential national security problem during a national emergency scenario that causes an import disruption. [TEXT REDACTED]

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Currently, all U.S. titanium sponge production comes from TIMET's single facility in Henderson, Nevada. Should this facility close, all titanium melters in the United States will be reliant on imported titanium sponge.

2. Although Imports of Sponge Are Increasing, U.S. Dependence on Non-U.S. Titanium Semi-Finished and Finished Products is Minimal

[TEXT REDACTED][88] The 2017 U.S. International Trade Commission (USITC) investigation found that TIMET was not considering becoming a merchant sponge producer.[89] ATI internally consumed all sponge produced at Rowley during the facility's period of operation and reported no outside sales of sponge during the USITC investigation period.

[TEXT REDACTED] The entire volume of U.S. titanium sponge exports from 1985 to 2014 totaled approximately 33,000 metric tons.[90] By comparison, Japanese titanium sponge exports in 2017 and 2018 alone exceeded a combined [TEXT REDACTED][91]

Although the United States imports a majority of its titanium sponge, there is no similar dependence on foreign sources for downstream titanium metal goods. It is important to note, however, that U.S. semi-finished and finished titanium production is subject to the same 68 percent import dependency on sponge and 52 percent import dependency on scrap.

During the 2014 to 2019 period, approximately 7,100 metric tons of titanium ingots were imported into the United States for consumption. During the same timeframe, U.S. exports of titanium ingot stood at approximately 45,000 metric tons (*See* Figure 26).

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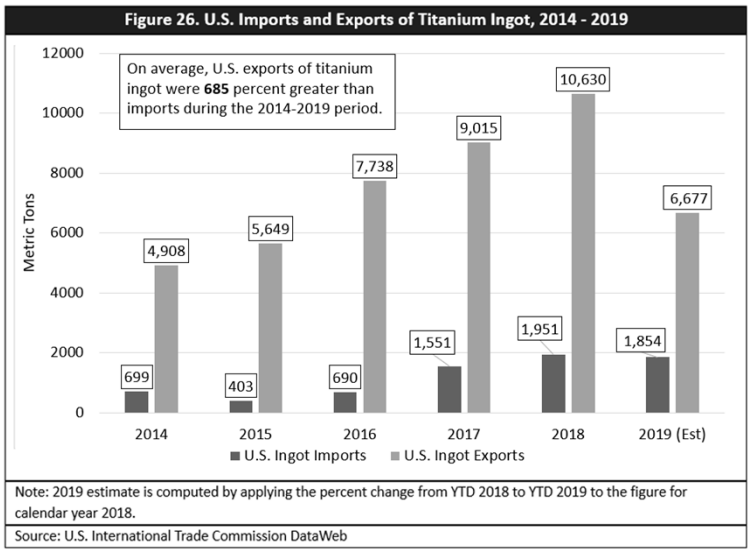
[88] [TEXT REDACTED]

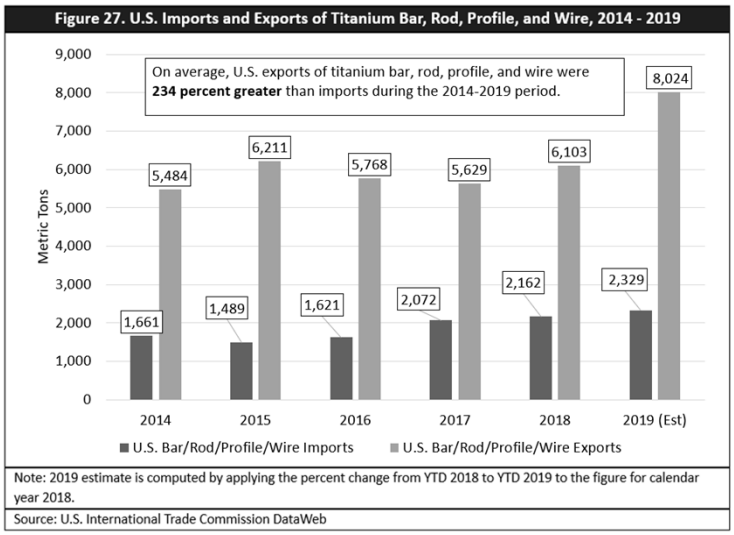
[89] USITC, Titanium Sponge from Japan and Kazakhstan, V-6

[90] USGS, "Titanium Sponge Statistics" (January 19, 2017)

[91] [TEXT REDACTED]



A similar phenomenon can be seen with titanium bars, rods, profiles, and wire (*See* Figure 27). In the 2014 to 2019 period, approximately 11,000 metric tons were imported into the United States compared to an approximate 37,000 metric tons exported. These high exports to imports ratios indicate a financially healthy and globally competitive U.S. titanium melt products industry.



High export volumes can be explained in part by extensive U.S. titanium melting capacity. Roskill Information Services estimated that, as of 2016, the United States possessed approximately 136,000 metric tons of melt capacity, approximately 31 percent of total global

melt capacity.[92] Only China, which is estimated to have an approximate 138,000 metric tons of melt capacity, is on par with the United States. China's melt capacity is currently largely used for domestic consumption, while U.S. titanium producers use their significant capacity to serve both domestic and foreign demand.

U.S. titanium metal production is also bolstered by high demand from U.S. aerospace firms such as Boeing, Lockheed Martin, Pratt and Whitney, and General Electric Aviation. These companies require considerable amounts of downstream titanium products, and the titanium sponge used as melt feedstock for these products is highly reliant on non-U.S. sponge. This reliance on foreign titanium sponge highlights the potential vulnerabilities of the titanium production supply chain in the event of a sponge import disruption.

3. Price History and Recent Price Trends

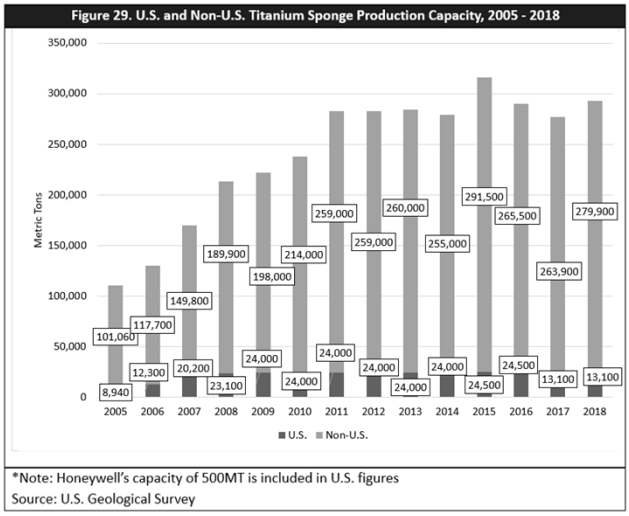
Overview

Although a 44 percent increase in titanium sponge prices between 2002 and 2018 suggests broad U.S. titanium sponge industry health, a deeper investigation of prices reveals difficulties for the industry. Falling prices after 2009, prompted by increased Chinese domestic production and industry trends such as increased scrap reversion, highlight the mid and long-term problems for U.S. sponge production. Titanium sponge price trends since 2002 are displayed in Figure 28.

[92] A 2013 presentation by Roskill Consulting Group estimates that Chinese producers Zunyi Titanium as well as the Pangang and Jichuan Groups produced small amounts of premium grade sponge in 2012. This material was used in Chinese domestic industry and was not exported. Philip Dewhurst, "Titanium Sponge Supply: Past, Present and Future", Presentation at the Titanium USA 2013 Conference in Las Vegas, Nevada, (October 9, 2013), https://cdn.ymaws.com/titanium.org/resource/resmgr/2010_2014_papers/DewhurstPhilipTiUSA2013Suppl.pdf, 21

Global Increases in Capacity and Production Depress Sponge Prices

Increased demand for titanium sponge incentivized the creation of additional global sponge capacity. Figure 29 shows increases in U.S. and non-U.S. titanium sponge production capacity from 2002 to 2018.



Though U.S. sponge capacity experienced net growth between 2005 and 2018 from 8,940 to 13,100 metric tons, U.S. capacity peaked in 2015 at 24,500 metric tons. These gains were lost in 2016 when ATI Rowley idled operations. ATI's closure represented a 46.5 percent decrease in U.S. sponge capacity from 24,500 metric tons in 2015 to 13,100 metric tons in 2018. In contrast, non-U.S. sponge capacity increased by approximately 178,840 tons, or 177 percent, between 2005 and 2018. These capacity additions were principally driven by China, Japan, and Russia in response to increasing global aviation consumption and other demand.

Continued increases in global titanium sponge production contributed to eventual declines in titanium sponge prices. Between 2009 and 2011, global sponge production increased 69 percent from 110,000 metric tons to 186,000 metric tons.[93] Most of these increases were seen in Japan and China, which boosted production by 26,000 and 25,000 metric tons respectively.[94] The average titanium sponge price declined by 48 percent as result, from $27.58 per Kg ($27,580 per metric ton) in 2009 to $14.31 per Kg ($14,310 per metric ton) in 2011.

Although production slightly declined after 2015, prices continued to fall due to market saturation. As sponge prices continued to decrease, some plants were idled due to declining market conditions. Chinese producers idled approximately 30,000 metric tons of capacity between 2015 and 2016, much of which had been built to capitalize on price increases in the late 2000s.[95] By 2016, sponge prices declined to $9.36 per Kg ($9,360 per metric ton). Although prices slightly recovered to $10.00 per Kg ($10,000 per metric ton) in 2018, the price is still 23 percent below 2003 levels.

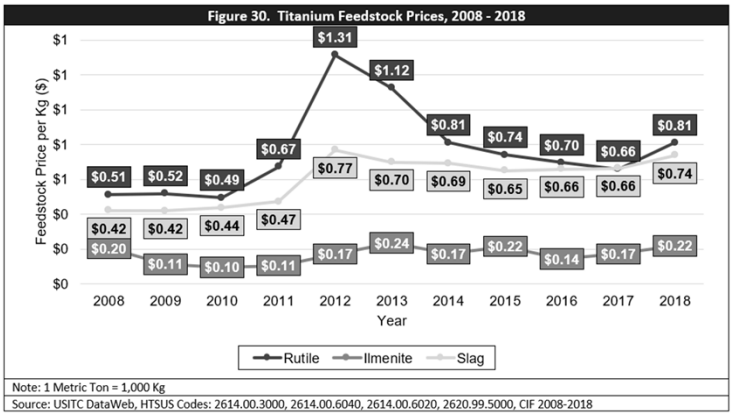
Cost of Feedstock Impacts Sponge Prices

Another factor influencing sponge prices and production are feedstock prices. Titanium sponge producers use several different types of feedstock in the Kroll process, including rutile and ilmenite ores as well as slag. Prices for these inputs are shown in Figure 30.

[93] U.S. Geological Survey, "Titanium and Titanium Dioxide: 2010" and "Titanium and Titanium Dioxide: 2012"

[94] Ibid.

[95] USGS Data.



On average, titanium sponge feedstock prices increased by 48 percent over the 2008 to 2018 period. The most profound increases were in rutile and ilmenite, which increased by 59 and 76 percent respectively. Although these price increases coincided with increases in global titanium sponge production, sponge production has only a limited impact on feedstock price increases.

Increased titanium dioxide production, which accounts for 93 percent of all industrial use of titanium feedstock, is the primary driver of these increases in feedstock prices. Between 2008 and 2018, global titanium dioxide capacity jumped 45 percent from approximately 5.3 million metric tons to approximately 7.7 million metric tons.[96] Expansions of Chinese capacity account for a significant portion of this increase: Chinese capacity increased 267 percent from approximately 900,000 metric tons to 3.3 million metric tons between 2008 and 2018.[97] Consequently, as global demand for titanium dioxide increases, feedstock prices also increase.

[TEXT REDACTED]

U.S. Cost of Titanium Sponge Production Compared to Import Prices

[TEXT REDACTED]

[TEXT REDACTED]

[96] U.S. Geological Survey, Titanium and Titanium Dioxide: 2009" and "Titanium and Titanium Dioxide: 2018"

[97] Ibid.

[TEXT REDACTED]	[TEXT REDACTED]	[TEXT REDACTED]	[TEXT REDACTED]	[TEXT REDACTED]
[TEXT REDACTED]	[TEXT REDACTED]	[TEXT REDACTED]	[TEXT REDACTED]	[TEXT REDACTED]
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[TEXT REDACTED]				

ATI cited both higher input prices, particularly $TiCl_4$, and availability of low-cost titanium sponge imports as drivers of its decision to idle its sponge plant in favor of purchasing from foreign suppliers:

> "…titanium sponge, including aerospace quality sponge, can now be purchased from qualified global producers under long-term supply agreements at prices lower than the production costs at ATI's titanium sponge facility in Rowley, UT….ATI has entered into long-term, cost-competitive supply agreements with several leading global producers of premium-grade and standard-grade titanium sponge."[98]

[TEXT REDACTED]

[TEXT REDACTED]				
[TEXT REDACTED]	[TEXT REDACTED]	[TEXT REDACTED]	[TEXT REDACTED]	[TEXT REDACTED]
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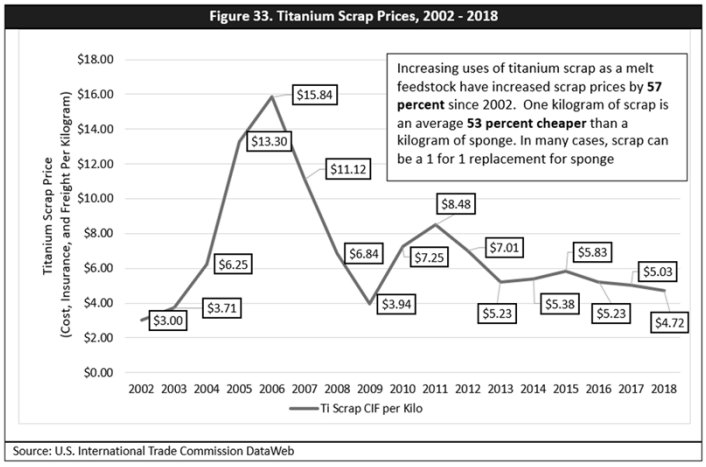
[TEXT REDACTED]				

[98] "Allegheny Technologies Announces Actions to Improve Future Financial Performance", *ATI* (August 24, 2016), https://ir.atimetals.com/news-and-events/news-releases/2016/08-24-2016-122218784

Low non-U.S. prices, as seen in Figure 32, inhibit domestic investment and the continuation of sponge production in the U.S. [TEXT REDACTED] [99] [TEXT REDACTED] However, high energy and labor costs in Japan raise the question of whether Japanese producers can continue to seemingly subsidize their exports of titanium sponge.

Increased Use of Titanium Scrap Affects Titanium Sponge Prices

Titanium scrap, which is generated during the downstream manufacturing process, can also be used as a source of feedstock for titanium melting operations. Titanium scrap prices increased substantially over the 2002 to 2018 period (*See* Figure 33).

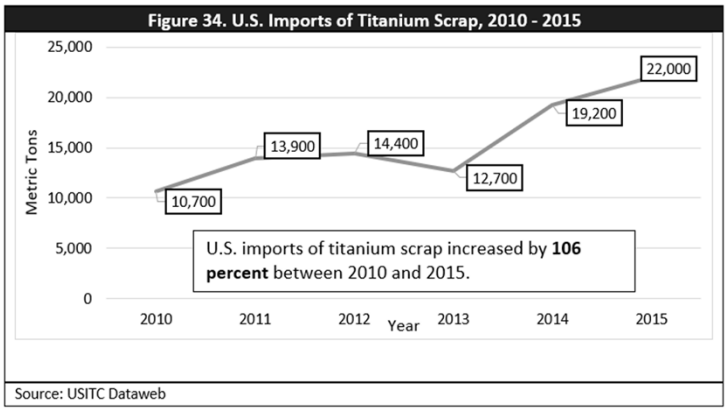


Increased scrap prices stem from downstream consumers' initiatives to recover scrap. In most cases, as a billet is forged, rolled, and/or machined to produce a finished good, excess titanium metal is produced. This metal can then be collected and returned to a titanium melter for reprocessing into another ingot or billet. Downstream consumers, particularly aerospace firms, seek to increase the amount of recycled scrap that they use in their products in order to realize cost-savings on input costs.[100]

[99] [TEXT REDACTED]

[100] Seong, Younoussi, and Goldsmith, "Titanium: Industrial Base, Price Trends, and Technology Initiatives", 15.

On average, approximately 40 to 50 percent of a given melt's feedstock comes from scrap.[101] This percentage, however, will vary depending on the customer's requirements for the alloy.[102] Globally, scrap accounts for an average of 31 percent of titanium producers' annual melt feedstock.[103] U.S. producers use even higher amounts, ranging between 59 and 66 percent.[104] U.S. producers also dramatically increased their titanium scrap imports in the first half of the 2010s, as shown in Figure 34.



One reason for the increased use of scrap is the aviation industry's use of the "buy to fly" (BTF) ratio. The BTF ratio specifies the amount of titanium required to produce a given part.[105] For example, if the BTF ratio for a given part weighing one pound is 20:1, 20 pounds of titanium metal is required to produce the part weighing 1 pound. New developments in metallurgy and manufacturing techniques have allowed for increased use of scrap in aerospace-grade titanium. In 2008, Boeing and VSMPO-Avisma announced the development of a titanium alloy that can use up to 75 percent scrap for its initial melt to be produced in Russia.[106] Additive manufacturing

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[101] Ibid.

[102] Purer alloys cannot use higher percentages of scrap. Some applications, such as billets for the F-35 Joint Strike Fighter, use no scrap whatsoever. Ibid., 17.

[103] U.S. Geological Survey

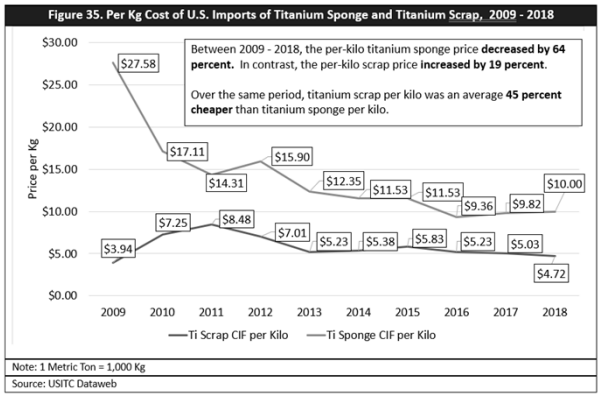
[104] U.S. Geological Survey

[105] Ibid., 18.

[106] The Boeing Company, "The quest for stronger, cheaper titanium alloys," (February 2018), https://www.boeing.com/features/innovation-quarterly/feb2018/feature-titanium.page

techniques, including 3-D printing and joining techniques such as linear friction welding and explosive forming, have the potential to reduce BTF ratios to 2:1 from the then-contemporary industry average of 10:1.[107] Manufacturers thus have significant financial incentive to recover and reuse scrap titanium.

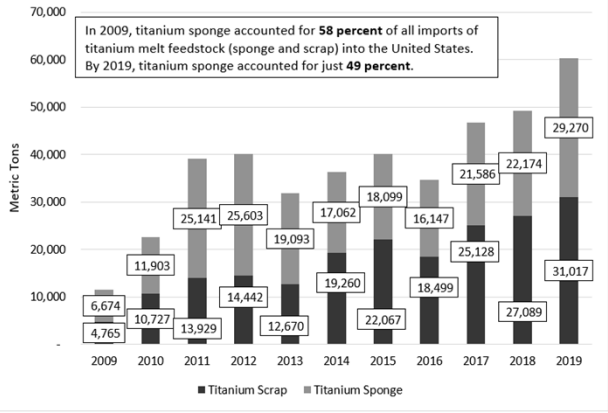
Another incentive for increasing scrap usage is due to the price difference between scrap and titanium sponge (*See* Figure 35).



Availability of cheaper scrap inputs incentivizes use of scrap material in place of titanium sponge where possible. Further, as aircraft production increased in the years following 2011, available scrap supplies increased. Increased availability caused scrap prices to decrease by 44 percent; in contrast, sponge prices only decreased by 37 percent. By 2018, the cost per Kg of scrap was 47 percent of that for a Kg of sponge (note: 1 metric ton equals 1,000 Kg). Increased use of titanium scrap has offset use of titanium sponge (*See* Figure 36). However, decreasing scrap prices are putting further financial pressures on the domestic production of titanium sponge.

[107] Guy Norris, "Metallics Make Comeback With Manufacturing Advances', *Aviation Week and Space Technology* (May 6, 2013), https://aviationweek.com/awin/metallics-make-comeback-manufacturing-advances

Figure 36. U.S. Imports of Titanium Sponge and Titanium Scrap, 2009 - 2019



Note: 2019 estimate is computed by applying the percent change from YTD 2018 to YTD 2019 to the figure for calendar year 2018.

Source: USITC Dataweb

Increased use of titanium scrap as feedstock does not, however, eliminate the need for new titanium sponge. In the United States, scrap accounts for approximately 59-66 percent of titanium melt feedstock.[108] Using scrap as a source of feedstock allows titanium manufacturers to offset price increases in sponge with increased consumption of scrap, or vice-versa.[109] However, the chemical composition requirements for aerospace rotating-grade titanium preclude usage of higher amounts of scrap. The inability to substitute high grade sponge with scrap emphasizes the importance of a secure supply of sponge for defense applications.[110]

It is also important to note the U.S. dependency on scrap, when combined with higher import levels of sponge, further jeopardizes the ability of the U.S. to produce titanium ingot, billet, and other downstream finished titanium products in a national emergency. Domestically produced titanium scrap is reliant on the availability of titanium sponge in the initial production of titanium goods. As imported sponge accounts for 68 percent of U.S. titanium sponge

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[108] U.S. Geological Survey

[109] Decreased aircraft production during 2003-2005 caused global shortages of titanium scrap; between 2003 and 2006, the average per-kilogram price of titanium scrap imports jumped 326 percent. In contrast, titanium sponge prices increased by only 66 percent. Imports of sponge thus increased by 136 percent of the period, compared to 130 percent for scrap. USITC Dataweb and Seong, Younoussi, and Goldsmith, "Titanium: Industrial Base, Price Trends, and Technology Initiatives" 36-37.

[110] Titanium scrap can contain non-titanium elements that cannot reasonably removed during the recycling and melt processes. The presence of these elements thus precludes use of significant amounts of scrap in higher grades of sponge.

consumption, U.S. titanium scrap production is similarly reliant on the availability of sponge imports.

4. Employment Trends

[TEXT REDACTED]

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[TEXT REDACTED]
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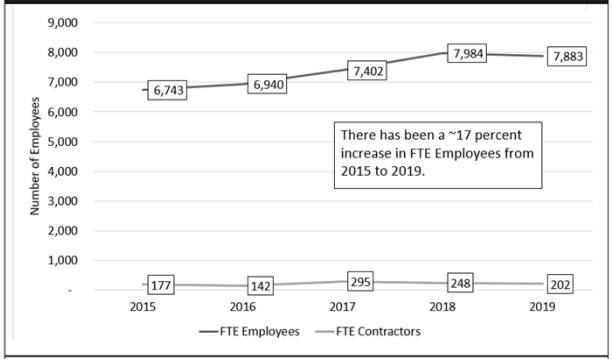
[TEXT REDACTED] These positions, about one third of the workforce, aside from maintenance and engineering and administration and management, require no formal education and have minimal on the job training requirements; maintenance and administration require bachelor's degrees and one to six months of on-the-job training.

[TEXT REDACTED]
[TEXT REDACTED]
[TEXT REDACTED]

[TEXT REDACTED] *Downstream Titanium Employment*

Employment in downstream titanium manufacturing has shown growth over the 2015 to 2019 period (*See* Figure 39).

Figure 39. U.S. Downstream Titanium Employment, 2015 - 2019



Source: U.S. Department of Commerce, Bureau of Industry and Security, Producers and Melters Survey, Q14A

4 Respondents

[TEXT REDACTED]

Stable employment in downstream titanium manufacturing indicates a broadly healthy sector. [TEXT REDACTED] [111]

[TEXT REDACTED] However, as reviewed in this section, stable downstream industry employment does not imply stability for employment in sponge manufacturing. The remaining [TEXT REDACTED] employees in the U.S. titanium sponge industry, all concentrated at TIMET's Henderson facility, will probably transfer to other industries and regions if sponge production ceases. By the time that old capacity was to be reactivated or new capacity built, it is unlikely that the required skills and technical knowledge would be readily available. Any effort to restore U.S. titanium sponge capacity would therefore incur additional costs and delays due to the need to train a new skilled workforce.

5. Financial Outlook

TIMET is the sole active titanium sponge manufacturer in the United States, and the firm's financial health highlights the status of U.S. titanium sponge production. [TEXT REDACTED] [112] [TEXT REDACTED]

[TEXT REDACTED]
[TEXT REDACTED]
[TEXT REDACTED]

[TEXT REDACTED][113] [TEXT REDACTED][114] [TEXT REDACTED] [115] [TEXT REDACTED]

6. Research and Development

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[111] [TEXT REDACTED]

[112] [TEXT REDACTED]

[113] Ibid.

[114] Ibid.

[115] U.S. International Trade Commission DataWeb

Overall titanium industry research and development expenditures increased over the 2015 to 2018 period for the five companies reporting (*See* Figure 41).

[TEXT REDACTED]
[TEXT REDACTED]
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Of these expenditures, an average of 11 percent went to basic research, 21 percent went to applied research, and the remaining 68 percent went to process development. [TEXT REDACTED]

An increase in overall industry R&D expenditures should not be taken as a sign of health for U.S. titanium sponge production. As discussed earlier in this report, the basic titanium sponge production process has remained unchanged for several decades. The expenditures reported in Figure 41 above likely pertain to downstream production processes, including advanced melting and additive manufacturing techniques, rather than sponge operations.

7. Capital Expenditures

Low-priced sponge imports have impeded U.S. producers' ability to make needed capital investments for future production. [TEXT REDACTED] [116] [117] [TEXT REDACTED] [118]

[TEXT REDACTED]

[TEXT REDACTED]
[TEXT REDACTED]
[TEXT REDACTED]

[116] Petition, 36.

[117] Business Confidential Exhibit 19, 9.

[118] Ibid, 8.

[TEXT REDACTED]

Low sponge prices had already harmed ATI's ability to continue sponge production operations at its Rowley, Utah plant, which was idled in 2016. The Rowley plant, unlike TIMET's facility, did not have the capacity to produce $TiCl_4$ or recycle magnesium, both of which are critical to sponge production. These materials were obtained from third parties and shipped by rail to the Rowley facility.[119] [TEXT REDACTED]

C. Diminishing U.S. Titanium Sponge Production Capacity May Impair the National Security in the Future

1. U.S. Production is Well Below Domestic Demand

Total consumption of titanium sponge in the United States was approximately 34,000 metric tons in 2018.[120] As identified earlier, total available U.S. titanium sponge capacity is only [TEXT REDACTED], representing approximately [TEXT REDACTED] of total U.S. demand. However, actual production in 2018 was approximately [TEXT REDACTED]. The entirety of current U.S. titanium sponge production satisfies just [TEXT REDACTED] of U.S. demand.[121]

[TEXT REDACTED] [122] [TEXT REDACTED] U.S. titanium melters will continue to rely on imported titanium sponge and scrap for the foreseeable future.

[TEXT REDACTED]
[TEXT REDACTED]
[TEXT REDACTED]

Surge Capability

[119] U.S. ITC, In the Matter of Titanium Sponge from Japan and Kazakhstan (701-TA-587 and 731-TA-1385-1386), p. 108.

[120] U.S. Geological Survey, "Titanium and Titanium Dioxide: 2019"

[121] U.S. Geological Survey, 2019 Mineral Commodity Summaries: Titanium and Titanium Dioxide, 174. https://prd-wret.s3-us-west-2.amazonaws.com/assets/palladium/production/atoms/files/mcs-2019-titan.pdf

[122] USGS reports that aerospace applications accounted for 80 percent of titanium sponge usage in 2018. The USGS figure does not appear to distinguish between commercial and military aerospace applications. Ibid.

The U.S. has some ability to utilize surge capabilities in the event of a national emergency through ATI's idled sponge facility. This reactivated capacity would add as much as [TEXT REDACTED] of titanium sponge production capacity. [TEXT REDACTED] However, given the non-integrated nature of the plant and the associated difficulties with obtaining titanium tetrachloride and magnesium inputs, the Rowley facility would face significant obstacles to full production. It is unclear whether the Rowley plant would be able to adequately meet emergency needs within a reasonable period of time.

2. Domestic Titanium Sponge Capacity Is Highly Concentrated and Limits Capacity Available for a National Emergency

Active U.S. titanium sponge production is concentrated exclusively at TIMET's plant in Henderson, Nevada. This plant, which began operations in the 1950s, is aging and will not be able to continue future operations without significant capital investments. ATI's plant in Rowley, Utah was indefinitely idled at the end of 2016 and the company [TEXT REDACTED]. Additionally, ATI's plant in Albany, Oregon was idled in 2009, when ATI Rowley began operations, and is now permanently closed without the ability to reopen. If TIMET does not replace the chlorination facility at Henderson by [TEXT REDACTED] and consequently closes its titanium sponge production facility, there will be no active titanium sponge production capacity suitable for industrial metal applications in the United States.[123]

Reduced sponge capacity already forces U.S. downstream producers into a heightened dependence on foreign suppliers. Although U.S. downstream producers have used imports to satisfy some of their production requirements for decades, the current level of import dependence is at a historic high. In 1988, U.S. titanium sponge production could fulfill all domestic consumption. By 2018, production at the last operational sponge facility fulfilled just [TEXT

[123] While it is expected that Honeywell Electronic Materials' plant in Bountiful, Utah will remain operational, as noted earlier, this plant does not currently produce titanium sponge suitable for most national defense and critical infrastructure applications.

REDACTED] of domestic consumption.[124] In an emergency scenario where imports were disrupted, U.S. downstream producers may not be able to continue normal melting and fabrication operations without access to titanium sponge and scrap imports.

In contrast, China and Russia have integrated titanium production capacity. In a hypothetical emergency scenario involving conflict between the United States and either China or Russia, the U.S. could soon lose its capability to manufacture titanium parts due to a lack of sponge availability and a finite supply of scrap. This would be further compounded by a cutback in imports of semi-finished and finished titanium products. China or Russia, in contrast, could continue titanium production without significant interruptions.

National emergency scenarios could potentially affect imports from Japan and Kazakhstan. In the event of a general conflict in the Pacific, including China and/or Russia, the United States may not be able to access titanium sponge or scrap imports from Japan. [TEXT REDACTED] [125] Loss of these imports and limited domestic sponge capacity from TIMET would effectively halt U.S. titanium metal production and could impair sustainment and assembly of aircraft and other defense systems requiring titanium.

[TEXT REDACTED] [126] While these capacity additions could mitigate import losses, shortages are still possible, and U.S. national security would be impaired.

These possibilities, in the Secretary's assessment, represent a significant weakening of the internal economy needed to support defense and critical infrastructure needs and threatens to impair the national security as defined in Section 232.

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[124] U.S. Geological Survey, "Titanium Sponge Statistics" (January 19, 2017)

[125] [TEXT REDACTED]

[126] [TEXT REDACTED]

3. [TEXT REDACTED]

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D. Increased Global Titanium Sponge Capacity and Production Further Impact the Long-Term Viability of U.S. Titanium Sponge Production

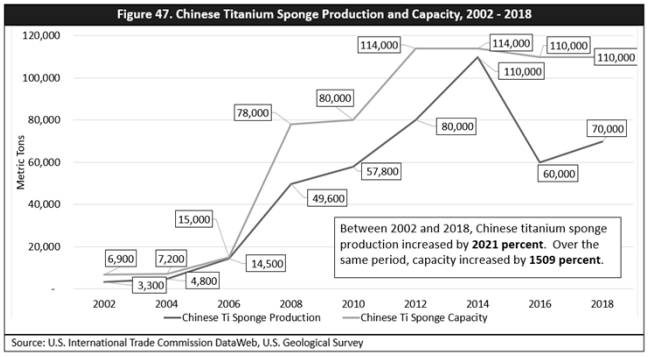
1. Extreme Growth in Chinese Titanium Sponge Production Will Place Downward Pressure on Global Titanium Sponge Prices

Although Chinese imports accounted for only 0.01 percent of all U.S. titanium sponge imports and 0.16 percent of downstream titanium imports (ingot and billet) in 2018, China's dramatic growth in titanium sponge production will contribute to overall downward pressure on

global titanium sponge prices.[127] This pressure may increase in the future if Chinese producers shift their business focus away from supplying domestic industry and towards exports of titanium sponge, ingot, and billet.

Currently, the Chinese are instead exporting a variety of finished products which contain titanium metal (bicycles, cookware, heat exchangers, condensers, automobile parts, structural aerospace parts, medical devices, construction materials, etc.).

As shown in Figure 47, Chinese producers have exponentially increased their sponge capacity and production over the past two decades.



These increases in capacity and production, facilitated in no small part by state assistance to producers, continued despite low global sponge prices. As reviewed earlier in this chapter, sponge prices in 2018 were 63 percent lower than their 2009 peak. Over the same timeframe, Chinese production increased by 14 percent and capacity by 41 percent. These increases in Chinese capability despite declining global prices suggest that, similar to the country's actions in the steel and aluminum industries, Chinese titanium sponge producers need not heed market signals in the same way as U.S. and other market producers.

[127] USITC Dataweb

China is virtually self-sufficient in titanium sponge production.[128] In 2018, estimated Chinese production may have been as high as 75,000 metric tons, compared to approximate total Chinese demand of 79,000 metric tons.[129] The gap between domestic production and consumption largely represents shortfalls in premium-grade sponge manufacture, which is currently being filled with imports. However, this gap will likely be lowered in the coming years. Chinese production of premium-grade sponge suitable for aerospace structures is already estimated to be 30 percent of total global capacity.[130]

Chinese demand for titanium sponge will increase over the coming decades due to rapid expansions in the country's chemical, aerospace, and electricity generation industries. In 2018, these three sectors consumed nearly three quarters of all titanium products produced in China.[131] Government initiatives emphasizing advanced manufacturing, including the Made in China 2025 plan, the *Chang'e* lunar exploration project, and development of domestic civilian airliners such as the C919 and CR929 will drive an increasing demand for titanium metal.

Chinese domestic near self-sufficiency in titanium production places significant pressure on other titanium producers. Foreign producers are currently able to access roughly 5 percent of the Chinese sponge market and, as China develops more premium-grade sponge capacity, will be further excluded. Further, it is anticipated that China will begin to export material once domestic production exceeds domestic demand.

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[128] TIMET testimony before the U.S. International Trade Commission, https://www.usitc.gov/trade_remedy/731_ad_701_cvd/investigations/2017/Titanium%20Sponge%20from%20Japan%20and%20Kazakhstan/Preliminary/titanium_sponge_from_japan_and_kazakhstan-conference-09-14-2017.pdf, 36

[129] Argus Metals, "Feed shortage hampers world Ti sponge ramp up" (May 16, 2019), https://metals.argusmedia.com/newsandanalysis/article/1904225

[130] Roskill, "Titanium Metal: Global Industry, Markets, and Outlook 2018 – 8th Edition"

[131] Exhibit 11, TIMET Rebuttal Comment: "Sylvain Gehler, World Titanium Sponge Supply Situation", 14.

The gap between Chinese capacity and production, therefore, is notable. The UGS estimates that only 63 percent of Chinese titanium sponge capacity was active in 2018, and China continues to increase sponge capacity.[132] If increased to full capacity, Chinese production would exceed combined Japanese and Russian sponge production. This potential illustrates the impact of Chinese production and capacity on the global market and highlights the impact China will have on the global market should their production focus switch towards exports. An increased presence of low-priced Chinese sponge in the global market would place further downward pressure on sponge prices and potentially force market producers, like Japan, to cut prices below economically viable levels in order to remain competitive in the export market.

Though China currently consumes almost all domestic production of titanium sponge, their large-scale capacity for mill products has allowed them to export approximately 23 percent of their ingot and billet production (no significant quantities are imported to the U.S.). Instead, China has been exporting large quantities of commercial and industrial products containing titanium (bicycles, heat exchangers, condensers, automobile parts, structural aerospace parts, medical devices, construction materials, etc.).

Increased Chinese exports of commercial and industrial products containing titanium (with a broader range than Russian exports of aerospace-focused titanium products), and a future focus on exports of titanium sponge, ingot and billet, are expected as China has implemented a similar strategy in other material markets.

Chief among export markets is the United States. The United States is the second largest market for titanium products in the world and is a natural focus for exports. [TEXT REDACTED] Existing availability of low-price imports has forced TIMET to consider the future of its own aging sponge production facility and its high production costs. Increased

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[132] U.S. Geological Survey, "Titanium and Titanium Dioxide: 2019", https://prd-wret.s3-us-west-2.amazonaws.com/assets/palladium/production/atoms/files/mcs-2019-titan.pdf

competition from Japanese producers due to rising Chinese production, as well as the potential for China to begin exporting more low-priced material to the U.S., may further depress sponge and scrap prices. A further reduction in import prices would make it even more difficult for TIMET to justify continued sponge production when low-priced imports are available.

2. Increased Chinese and Russian Premium Quality Sponge Production Threatens U.S. Aerospace Supply Chains

Premium quality sponge is required for rotating aircraft parts, particularly in engines. As highlighted earlier, not every titanium sponge plant is certified to supply premium quality sponge. The certification process requires extensive consultation with equipment manufacturers and testing of sponge samples to ensure chemical purity. Most U.S. and European Union aerospace firms have at some point granted certification to six producers: TIMET, ATI, Toho Titanium, Osaka Titanium, VSMPO-Avisma, and UKTMP (Kazakhstan).[133]

Although China has not yet produced aerospace non-rotating grade titanium sponge for export, Chinese producers have produced it for domestic consumption.[134] Aerospace non-rotating grade sponge is believed to have been used for structural aerospace applications in Chinese military airframes. However, it is not clear whether Chinese producers are capable of producing aerospace rotating-grade titanium sponge at this time.

As noted earlier, China will need increasing amounts of aerospace non-rotating titanium sponge in the future to support new initiatives in the aerospace sector. Furthermore, Chinese government objectives of self-sufficiency in aircraft engine production will require the

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[133] Prior to its 2016 idling, ATI had obtained certification for its Rowley facility.

[134] A 2013 presentation by Roskill Consulting Group estimates that Chinese producers Zunyi Titanium as well as the Pangang and Jichuan Groups produced small amounts of premium grade sponge in 2012. This material was used in Chinese domestic industry and was not exported. Philip Dewhurst, "Titanium Sponge Supply: Past, Present and Future", Presentation at the Titanium USA 2013 Conference in Las Vegas, Nevada, (October 9, 2013), https://cdn.ymaws.com/titanium.org/resource/resmgr/2010_2014_papers/DewhurstPhilipTiUSA2013Suppl.pdf, 21

development of aerospace rotating grade sponge capacity.[135] The Department anticipates that future Chinese activities in titanium sponge will follow the same pattern as their activities in the global steel and aluminum trade, namely price-insensitive production that will undermine all other competitors.[136]

Russia's activities in global titanium sponge trade suggest a precedent for future Chinese activity. Russian producer VSMPO-Avisma, like many Chinese producers, receives a significant amount of state assistance.[137] VSMPO-Avisma is also an integrated producer of titanium sponge and downstream titanium products, and is able to offer titanium products at lower prices than U.S. or European producers.

These low prices and favorable contract terms were a major incentive behind Boeing's 2006 joint venture with VSMPO-Avisma to establish Urals Boeing Manufacturing (UBM) at Verkhnyaya Salda in Sverdlovsk Oblast.[138] The UBM plant creates titanium forgings from VSMPO-manufactured sponge and ingot for use in Boeing's 787 aircraft. In 2018, Boeing and VSMPO-Avisma announced plans for a second $82.3 million production line at UBM that would support the 787, 737 MAX, and 777X aircraft. Altogether, VSMPO-Avisma provides 35 percent of Boeing's titanium products. European manufacturer Airbus is similarly dependent on

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[135] At present, Chinese civil and military aircraft manufacturers rely on engines from U.S., European Union, and Russian companies. To counteract this dependence, the Chinese government created the Aero Engine Corporation of China in 2016 as an integrated engine manufacturing firm. Development of premium grade titanium sponge capacity complements this effort to build a domestic aircraft engine industry. BBC News, "China launches own aircraft engine-maker to rival the West" (August 29, 2016), https://www.bbc.com/news/business-37212009

[136] Section 232 steel report, 52-53, https://www.bis.doc.gov/index.php/documents/steel/2224-the-effect-of-imports-of-steel-on-the-national-security-with-redactions-20180111/file, and Section 232 aluminum report, 102, https://www.bis.doc.gov/index.php/documents/steel/2224-the-effect-of-imports-of-steel-on-the-national-security-with-redactions-20180111/file

[137] Russian state holding company Rostec owns a blocking interest of 25 percent in VSMPO-Avisma. VSMPO-Avisma has also passed through several periods of outright control by the Russian state; additionally, VSMPO management has significant ties to the Russian government.

[138] The Boeing Company, "Boeing and VSMPO-AVISMA Announce Titanium Agreement", (August 11, 2006), https://boeing.mediaroom.com/2006-08-11-Boeing-and-VSMPO-AVISMA-Announce-Titanium-Agreement

VSMPO-Avisma's exports. In 2009, Airbus signed a $4 billion agreement with the firm to supply titanium through 2020.[139] As of 2019, VSMPO-Avisma supplied approximately 50 percent of Airbus's annual titanium requirements.[140] Although VSMPO-Avisma is not a significant exporter of sponge, its ventures with Boeing and Airbus indicate an interest in increasing the company's share of the global titanium aviation parts market.

Lower prices, made possible by Russian state support, allow VSMPO-Avisma to capture a significant share of Boeing's business. [TEXT REDACTED]

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VSMPO-Avisma's export model could easily be copied by a Chinese manufacturer in the future. A fully integrated Chinese titanium sponge and downstream titanium producer could offer U.S. and other market aerospace firms significant cost savings over market titanium sponge and titanium product producers. Such an outcome would threaten the future viability of market production of aerospace grade titanium sponge, including U.S., Japanese, and Kazakhstani production.

If Chinese production assists in the displacement of market production of aerospace grade sponge, global aircraft manufacturers, including those in the United States and European Union, will depend on state-influenced Russian and Chinese sources of titanium metal. Russia and China could then use their de facto dominance of the global titanium sponge industry as a tool of geopolitical leverage, as they have with other industries such as uranium and steel. Additionally,

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[139] Eleonore Demry, "Russia, Airbus Sign $4 Billion Titanium Deal), *Agence France Presse* (April 20, 2009), https://www.industryweek.com/companies-amp-executives/russia-airbus-sign-4-billion-titanium-deal

[140] "Interview: Julien Franiatte, head of Airbus Russia", *Russian Aviation Insider* (August 27, 2019), http://www.rusaviainsider.com/interview-julien-franiatte-head-of-airbus-russia/

in the event of an emergency potentially involving hostilities with Russia or China, U.S. titanium production would be severely impaired if deprived of imports from these countries. As Russia and China are both identified in the 2017 National Security Strategy as "revisionist powers…that challenge U.S. values and interests,"[141] dependence on these countries for titanium sponge would threaten to impair the national security.

VIII. Conclusion

Based on these findings, the Secretary concludes that the present quantities and circumstance of titanium sponge imports are "weakening our internal economy" and threaten to impair the national security as defined in Section 232. The consequent adverse impact on the domestic titanium sponge industry, along with the circumstance of increased global production and capacity in titanium sponge, especially in non-market economies, places the United States at risk of losing the remaining industrial capacity and technical knowledge related to titanium sponge production that is essential to meet national defense and critical infrastructure requirements.

Imports of titanium sponge, which accounted for 68 percent of all sponge consumed in the United States in 2018, threaten to impair the national security by placing the sole remaining U.S. titanium sponge producer's operation under severe financial stress. Low-priced sponge imports, as well as low priced titanium scrap imports, depress the price of U.S. titanium sponge and de-incentivize recapitalization of the remaining active facility's aging production capabilities. If the remaining facility ceases operation, the U.S. will have no active domestic capacity to produce titanium sponge for national defense and critical infrastructure needs.

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[141] Executive Office of the President, "National Security Strategy of the United States of America", (December 2017), 25.

Absent domestic titanium sponge production capacity, the U.S. will be completely dependent on imports of titanium sponge and scrap and will lack the surge capacity required to support defense and critical infrastructure needs in an extended national emergency.

Titanium producers, including producers of goods such as ingot, billet, sheet, coil, and tube, as well as end-users of finished titanium goods, are almost all entirely dependent on non-U.S. sources for sponge and scrap. This circumstance presents the possibility that, in a national emergency, U.S. titanium producers would be denied access to imports of titanium sponge and scrap due to supply disruption. If U.S. titanium producers do not have access to either domestic or imported supplies of sponge and scrap, their manufacturing operations would severely decline or cease once their existing titanium inventories were depleted. These working and strategic inventories have decreased substantially during the 2015 to 2018 period and are now estimated to only last approximately five months at current consumption rates. The U.S. no longer maintains titanium sponge in the National Defense Stockpile.

Further, under current global market conditions and the going rate of non-market Russian and Chinese titanium producers, it is difficult for the remaining U.S. titanium sponge producer to justify the capital investments needed for continued operations. This inability to invest threatens continued operation of the sole domestic titanium sponge plant. If this capacity and associated skilled workforce are lost, it will be challenging and prohibitively expensive to reconstitute U.S. titanium sponge production capabilities.

The Department acknowledges that larger industry trends, including increased use of titanium scrap and downstream producers' emphasis on scrap recovery, have decreased the need for titanium sponge. These trends reflect U.S. titanium producers and end users' interest in maximizing profits by leveraging lower scrap costs and mitigating the need for new sponge purchases. However, these trends do not eliminate the need for new titanium sponge. Certain titanium parts, particularly those used in national defense systems, cannot be made using scrap

and require new titanium sponge. Moreover, approximately 52 percent of all scrap is imported and subject to the same potential supply disruptions as sponge. The remaining 48 percent of scrap that is domestically produced is also subject to potential supply disruptions. The vast majority of this scrap is generated from semi-fabricated and finished titanium product manufacturing operations, which rely on imported sponge for approximately 68 percent of their total sponge consumption.

The displacement of domestic titanium sponge by low-priced imports places the United States at risk of not being able to meet national security requirements during an emergency. The Secretary therefore finds that imports of titanium sponge threaten to impair the national security as defined in Section 232.

Recommendations

The Department has identified several potential actions that could be taken to address the threat of imports of titanium sponge to national security.[142] These actions include domestic initiatives and multilateral negotiations.

Option 1 - Domestic Initiatives

The Department has identified two possible domestic initiatives that the U.S. government can undertake to stimulate reinvestment in domestic sponge production. These options include:

Option 1A – Voluntary Agreements with U.S. Titanium Sponge Producer(s) Under Title VII of the Defense Production Act of 1950

One of the challenges identified by the U.S. industry is that low prevailing market prices, which are driven by high volumes of imports, do not justify the capital investments required to sustain future production. To mitigate this situation, the U.S. government could temporarily

[142] The following recommendations are the Department's and do not necessarily reflect the recommendations of the other agencies with which the Department consulted during the course of this investigation.

compensate U.S. producer(s) for the difference between their current production costs and global purchase prices.

Such compensation would serve as a temporary bridge until such time that U.S. producer(s) could make the capital investments needed to upgrade or build production facilities, which will in turn lower production costs and safeguard future production. Although the proposed compensation is not likely to cover the full cost of any major capital investment, it would nevertheless encourage U.S. producers to invest their own funds in modernizing sponge production.

As shown in Figure 1A below, the Department estimates that providing this compensation over a five-year period would cost approximately [TEXT REDACTED] per year, or approximately [TEXT REDACTED] of titanium sponge produced. The Department bases these calculations on the remaining active U.S. producer of titanium sponge and assumes a five-year period would be required to make the essential capital investments needed to safeguard production. After completion of needed capital investments, U.S. production costs are expected to be competitive with the global sponge prices, and the compensation would no longer be required.

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Option 1B - Expansion of the National Defense Stockpile to include titanium sponge and additional amounts of titanium metal

The USG also could address the threatened impairment by adding additional titanium materials to the National Defense Stockpile, while simultaneously encouraging the upgrade of domestic sponge production capacity by instituting long-term supply contracts for U.S. producers of titanium sponge and metal. To encourage domestic sponge production, the agreement for this additional material would specify that the winning bidder(s) agree to provide U.S.-origin titanium sponge and domestically melted semi-finished titanium products to fulfill the anticipated 15-year contract.

In order to safeguard against supply chain disruptions, the proposed National Defense Stockpile would maintain one year's worth of U.S. titanium sponge consumption needs (combined defense and commercial). Department survey data on U.S. producers and melters' 2018-2019 inventories, consumption, and costs were used to calculate and estimate needs for this proposed stockpile. In 2018, 34,100 metric tons of titanium sponge were consumed in the U.S. The sole domestic manufacturer of titanium sponge produced sponge at a cost of [TEXT REDACTED]. Additionally, [TEXT REDACTED] of titanium sponge was held by U.S. commercial producers in their inventories in 2018. In order to maintain one years' worth of U.S. consumption in the proposed stockpile (34,100 metric tons total), the USG would have to procure [TEXT REDACTED] of titanium sponge in order to supplement the 2018 commercial inventory level of [TEXT REDACTED]. The agreement would stipulate that commercial inventory levels cannot be sold or liquidated and must be maintained at 2018 levels.

A 15-year agreement to procure the total shortfall of [TEXT REDACTED] would require the purchase of roughly [TEXT REDACTED] of titanium sponge per year, at an average price of [TEXT REDACTED], for a cost of [TEXT REDACTED]. The 15-year agreement would result in the procurement of [TEXT REDACTED] of sponge for the stockpile maintained by the USG at a total cost of [TEXT REDACTED]. However, the final amount and mix of sponge and metal

(titanium ingots and billets) to be added would be determined by the DoD in consultation with the Department and other agencies. Commercial inventories in the U.S. (including inventories of non-U.S. suppliers) and other factors that could impact demand in a national emergency would be factored into the acquisition plan.

Option 2 - Multilateral Negotiations

As the Department observed in the recent steel, aluminum, and uranium Section 232 investigations, non-market actors can substantially distort the global market for products through price, quantity, and market access. For titanium sponge and downstream products, Russia and China are examples of such non-market actors. In 2018, Russian and Chinese titanium sponge producers accounted for 61 percent of the world's titanium sponge production, an increase over their combined 55 percent share in 2008 and 37 percent share in 1998.

Non-market actors lower the price of titanium sponge, which causes financial harm to U.S. and other market producers, particularly Japan. Japanese producers have responded to low global prices by lowering their own sponge prices. Multilateral negotiations between the United States and other market producers of titanium sponge, including Japan and Kazakhstan, would present an opportunity to address issues affecting market titanium sponge production. The option below is budget neutral.

Option 2 – Common inventory of sponge for use among the parties to mitigate supply issues

In this option, the U.S. and other market titanium producers could agree to establish pre-positioned strategic stores of sponge for use by titanium sponge customers to be held at their U.S. titanium facilities or other locations in the United States. The amount of sponge held would vary with the annual amount sold to each particular customer commensurate to their market share. This action would mitigate potential shortfalls in sponge imports caused by a national emergency.

U.S. Titanium Industrial Base Analysis

The Department, in collaboration with DoD, DOI, and USGS, should survey and assess the operating status and capacity of the U.S. titanium sponge and downstream titanium industries every three years. Such action would provide the USG with needed economic and financial data on this critical industrial base sector.

Matthew S. Borman,

Deputy Assistant Secretary for Export Administration.

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