# Alum in Ancient Mesopotamian Technology

*By Martin Levey* *

ALUM occupies a unique position in the history of chemistry.[1] To judge by the standards of the ancients, it was one of the few known compounds naturally obtainable in a more or less pure state. In a period when almost all other substances used in daily chemical technology were obtainable naturally in a relatively impure and contaminated state, the greater purity of alum is explainable in a variety of ways.

Alum when pure is white, or colorless in aqueous solution. When tinged by color, for example, by ferrous salts, it may be purified by very simple processes until its white color is obtained. Second, it is readily crystallized in aqueous solution so that it may easily be separated from most impurities by fractional crystallization. In fact, alum may be purified without any difficulty by recrystallization, free of iron, and more readily than aluminum sulfate. Furthermore, alum is extremely soluble in hot water and at 20° C dissolves to the extent of 11.4 grams per 100 cubic centimeters of water.[2] This differential is an advantage in its purification.

In addition, alum, or more definitely potash alum, $KAl(SO_4)_2 . 12\ H_2O$, is sometimes found in the crystalline octahedral form in nature. Potash alum may easily be obtained from the naturally occurring alunite or alum-stone, $K_2SO_4.3Al_2SO_4(OH)_4$ by roasting with exposure to air, followed by lixiviation and crystallization.

When prepared by this method, the alum is relatively free from soluble iron compounds, although it may have a slightly brown or pink coloration due to $Fe_2O_3$. Ancient Mesopotamian literature often refers to alum with the determinative "aban," stone. For example, in a Middle Assyrian letter, we have, "Open the storehouse of alum ($NA_4$ ab-ne ga-bi-a) bring out one talent of alum." [3] Another text of the first millennium B.C. also describes alum as "aban gabû," giving its price as 10 minas of Egyptian alum for 12 shekels of silver.[4] Many other texts write alum in this manner.[5] Sometimes it is written not as "gabû" but as "aban šikkati," this latter probably being the alum-stone or alunite.[6] "Aban gabû" is most likely crystallized alum. Another way of writing alum in Sumerian is (IM.SAḪAR) $NA_4$.KUR.RA, "powder of the stone of the mountain," or "powder of alum." [7] [8]

Another simple method of preparing alum makes use of alum shale. In this connection, it is interesting that the word for alum in Sumerian prefaced by

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[2] Hodgman, C. D., *Handbook of Chemistry and Physics*, (Cleveland: Chemical Rubber Pub. Co., 1951, 33rd ed.).

[3] Ebeling, E., "Keilschrifttexte aus Assur verschiedenen Inhalts," *Wissenschaftliche Veröffentlichung der deutsche Orient-Gesellschaft*, 1920, *35*: text 109:18–20.

[4] Strassmaier, J. N., *Inschriften von Nabonidus*, (Leipzig: Pfeiffer, 1889), Text 20:12.

[5] *Ibid.*, 938.

[6] Zimmern, H., *Akkadische Fremdwörter*, (Leipzig: Hinrichs, 1915), p. 61.

[7] Ḫarra-ḫubullum lexical list, XI, 313.

[8] Ebeling, E., "Keilschrifttexte aus Assur religiösen Inhalts," *Wiss. Veröff. dtsch. Orientges.* 1922, *34*: Text 56, rev. 13.

IM.SAḪAR, the term for dust and clay, suggests perhaps a shale [9] from which alum may be derived. In this process, the aluminum silicate usually permeated by $FeS_2$ is roasted in heaps to yield aluminum sulfate. This in turn is lixiviated and evaporated, whereupon $K_2SO_4$ or $(NH_4)_2SO_4$ is added to deposit alum.

***Occurrence and Varieties.*** Alum, in this inquiry, is taken to indicate $KAl(SO_4)_2.12H_2O$, sometimes written as $K_2SO_4.Al_2(SO_4)_3.24H_2O$. The correct name for this is potassium alum. The ammonium alums are also fairly common. These alums, in contrast to aluminum sulfate, crystallize easily in octahedra.

Ancient alum, when used in an impure state, was probably potassium alum contaminated with iron sulfate. In classical antiquity these sulfates were often confused, partly because they had a number of resemblances in their physiological properties and their similar technological uses.

In Mesopotamia, there were both native and imported alum. A Neo-Babylonian letter reads, "Send me 2 kur of alum from Kašappu," [10] Egyptian alum is mentioned in a number of texts,[11] as is the alum from the land of the Hittites in a tanning text.[12] Ancient alums occur in the literature as "white alum," "black alum," "alum," [13] "male red alum," [14] and in other forms. The "male red alum," used in the making of glass, is probably a ferric oxide containing alum. "Black alum," "kitmu," and "white alum" are still unidentified. In a lexical text, alum is mentioned along with such substances as orpiment, gypsum and red chalk.[15] [16]

***Uses of Alum.*** In ancient Mesopotamia, alum enjoyed wide employment in diverse technologies such as tanning, dyeing, glass-making, washing and in medicine. In classical times, alum was also used as a flux to solder copper, to make wood fireproof and by metallurgists to separate silver and gold. No evidence exists, however, that these techniques originated in Mesopotamia.

Alum is frequently mentioned in the treatment of disease. One tablet reads, "You will crush alum and blow it into his ears with a . . . reed." [17] For a head itch, alum, sumach, and Nigella in honey are bound on the head.[18] In another application, alum is ground together with rose extract and nitrates in "ḫimetu ghee" to be applied perhaps as a salve.[19] For jaundice, alum was compounded with five herbs.[20] In a text, the meaning of which is uncertain, we read, "imḫurlim, tamarisk-seed, alum, and three drugs against the 'hand of the ghost,' he will drink and get well." [21] For the eyes, alum was used with other ingredients in a prescription.[22]

Alum was used for washing [23] [24] when it was written "aban šikku" or "šik-

[9] Thompson, R. C., *A Dictionary of Assyrian Chemistry and Geology*, (London: Oxford University Press, 1936), p. 33.

[10] Clay, A. T., *Neo-Babylonian Letters From Erech* (New Haven: Yale University Press, 1919), Text 14:8.

[11] *Ibid.*, Text 20:19; Strassmaier, J. N., *op. cit.*, Text 214:3.

[12] Ebeling, E., *op. cit.*, Text 60:7–8.

[13] Matouš, L., "Die Lexikalischen Tafelserien der Babylonier und Assyrer," *Vorderasiatische Abteilung der Staatliche Museen*, (Berlin, 1933), vol. I, Text 88:6.

[14] Thompson, R. C., *On the chemistry of the ancient Assyrians* (London: Luzac, 1925), Plate 3:68, Plate 6:8.

[15] Ḫarra, pp. 310–316.

[16] Uruanna list, III, pp. 506–508, 511.

[17] Thompson, R. C., *Assyrian Medical Texts* (London: Oxford University Press, 1923), Text 35, 2, col. 2:5.

[18] Ebeling, E., *op. cit.*, p. 202, col. 2:6.

[19] Thompson, R. C., *op. cit.*, 15:6, 8.

[20] *Cuneiform Texts in the British Museum* (London: British Museum, 1902), XIV, Text 48.

[21] Thompson, R. C., *op. cit.*, Text 76, 1::3.

[22] Scheil, V., "Catalog de la collection Eugène Tisserant," *Revue d'Assyriologie*, 1921, *18*: p. 6, 10:11–14.

[23] *Cuneiform Texts in the British Museum* (1903), XVI, Text 11:35.

[24] *Cuneiform Texts in the British Museum* (1906) XXIII, Text 43:10.

katu." [25] In a medical text, alum is used together with carbonates and nitrates to cleanse the mouth.[26]

In the glass tablets, "red male alum," $^{NA}_{4}$ ga-bi-e DIRI NITÁ, occurs in the following reading, "You will take 5 KISAL of (red male alum) 6 KISAL of orpiment, etc." [14]

In tanning, the use of alum is widely attested. In a first millennium B. C. tablet, we read,

(. . .) minas 6 shekels of alum
(. . .) minas gall nut extract (tannin), for tanning
11th day of the month of Aiaru
for Kidinnaia
worker in hides, having been curried
month of Aiaru, 6th day
3rd year
of Cambyse
king of Babylon, king of the world.[27]

A Middle-Assyrian economic text mentions "alum for work on a chariot [given] to P, the leatherworker." [28]

A magical text describes the tanning process. "You will steep the hide of a young goat (to make it supple) with milk of a yellow goat and with flour, apply fine oil, ordinary oil, fat of a pure cow. You dissolve the alum in pressed wine and fill the surface of the hide with gall-nut extract (grown) by Hittite gardeners." [29] [30] This process is known today in the Near East, where the skins are made into bags, filled with the tanning solution, and thrown into vats of the same solution.

Magical and ritual texts are often thought to reflect the customs and technologies of an ancient and almost forgotten past. Although the magical text above and the ritual text to follow were written in the first millennium B. C., they indicate more ancient methods in the use of alum. This is seen in the following ritual of Kalu.[31] "Thou shalt take the hide of this bullock and in gum flour of pure wheat, in aqueous solution, in the best beer, in wine thou shalt steep it, in fat of a pure bullock and aromata taken as extracts of plants with 4 qa of kur-ru flour thou shalt place it. Thou shalt press it with gall-nuts and Hittite alum." This hide was destined to be stretched on the kettle drum which accompanied the "kalû" in chanting his lamentations.

In this tablet, which refers to a distant past, we have a representation of various types of tanning, oil tannage, tanning with alum and also with tannin. It is possible that to the most ancient method of oil tanning, the alum and gall-nut addition was made later to endure the proper results, sometime about or before the protoliterate period.

It is of interest to note that no text has been found which describes tanning with alum alone, i.e., the alum and collagen formation, or tawing, as it is known. Skins treated with alum alone are incompletely tanned. They have a marked instability toward atmospheric humidity and water, since the aluminum salts within the fibers hydrolyse with formation of mineral acids. Further-

[25] Thompson, R. C., *op. cit.*, pp. 176f.; see also Ebeling, E., *op. cit.*, Text 376:22.
[26] Thompson, R. C., *op. cit.*, Text 54, 1, rev. 9.
[27] Strassmaier, J. N., *Inschriften von Cambyses* (Leipzig: Pfeiffer, 1890), Text 155.
[28] Ebeling, E., *Keilschrifttexte aus Assur juristischen Inhalts* (Leipzig: Hinrichs, 1927), Text 223:1.
[29] Rawlinson, H. C, *A Selection from the Miscellaneous Inscriptions of Assyria* (London: British Museum, 1891), IV, Text 28, 3, rev. 4.
[30] Thureau-Dangin, F., "Notes Assyriologiques," *Revue d'Assyriologie*, 1920, *17*: 29.
[31] Thureau-Dangin, F., "La Rituel du Kalû," *Revue d'Assyriologie*, 1920, *17*: 56.

more, tawing produces hides which are very hard and thin. There is no evidence that either sodium chloride or sulfate was used with alum in ancient Mesopotamia. These would counteract the deleterious effect of the tawing process.[32]

In dyeing, alum played no less a role than in tanning. Ancient Mesopotamia in the third millennium B. C. possessed a highly developed textile industry. Dyes ranging from very light to black were well known. Many are still unidentified, but the texts list alum as used with some of them, usually at the same time in a vat, e.g., "inzaḫurētu" with alum,[33] "dimuru" with alum to dye "biršu" wool,[34] "gurabu" dye with Egyptian alum.[35] Alum was used in dyeing the headdress of the gods,[36] and is listed in economic documents relating to dyers.[37] In one of these,[38] a memorandum also gives sodium carbonate, probably in a cold dilute solution to brighten a light color on cotton.

Uncertainty surrounds the exact method of using alum in these texts, since no complete description of the process has ever been unearthed. In wool dyeing, for example, especially for darker colors, mordanting or "saddening" may follow the dyeing or "stuffing." Alum contaminated with soluble iron salts would be very effective in this method.

Alum seems to have played a role in cosmetic dyeing preparations. In one text, alum is ground and the hair anointed in cedar oil.[39] To dye hair, alum is used together with cedar oil and Anthemis [40] to give a yellowish color.

***Importance of Alum.*** As one of the earliest compounds probably known in a pure state, alum occupies a significant position in the history of ancient chemistry. It was important in dyeing, tanning, pharmaceutical, and other technological operations. In ancient Mesopotamian chemistry, it is one of the few chemicals identifiable today with certainty. Its uses are widely cited in the literature, thus attesting further to its early identification. The extensive use of alum in both Mesopotamia and Egypt would explain its extensive application in the later classical period.[41] What Singer has called "the earliest chemical industry" has now been dated back to early Mesopotamian times, thus assuring its place as one of the first in historic antiquity.

[32] McLaughlin, G. D. and E. R. Theis, *The Chemistry of Leather Manufacture* (New York: Reinhold, 1945), p. 656.

[33] Strassmaier, J. N., *Inschriften von Nabonidus*, Text 214:5.

[34] Strassmaier, J. N., *Inschriften von Cambyses*, Text 156:1–3.

[35] Contenau, G., *Textes Cunéiformes*, Tome XII, Contrats Néo-Babyloniens (Paris: Geuthner, 1927), Text 84:5.

[36] Strassmaier, J. N., *op. cit.*, Text 156:2.

[37] Strassmaier, J. N., *Inschriften von Nabuchodonosor*, (Leipzig: Pfeiffer, 1889), Text 392:1–6.

[38] Harper, R. F., *Assyrian and Babylonian Letters*, (Chicago: University of Chicago Press, 1896), Text 347, rev. 8–9.

[39] Thompson, R. C., *op. cit.*, Text 3, 5:9.

[40] *Ibid.*, Text 5, 1:4.

[41] Singer, C. J., *The Earliest Chemical Industry* (London: Folio Society, 1948).