Developments in the

Application of Activated Carbon to Cyanidation

Including the Desorption of Gold and Silver from Carbons

by E. H. Crabtree, Jr.,
V. W. Winters, and
T. G. Chapman

This paper traces the experimental and pilot plant work completed by the authors since 1939 including the various methods which have been developed in applying coarse activated carbon to cyanidation. The methods and results developed by the authors in desorbing gold and silver from carbons are given and the possibilities for the re-use of the desorbed carbons are discussed.

IN 1939 one of the authors* described advances in carbon-cyanidation for the period 1932 to 1939 and included: (1) the dissolution of gold in an ore pulp by cyanide and its simultaneous adsorption by carbon, (2) the stage addition of adsorptive carbon and its movement countercurrent to the flow of the ore pulp, and (3) the recycling of adsorptive carbon. Considerable additional experimental and pilot plant work have been done by the authors since 1939 and the results of such work have been sufficiently encouraging to justify a second paper.

Developments from 1939 to 1948: In 1941, Verne W. Winters did the first experimental work in eliminating agitation during dissolution and adsorption and thereby demonstrated that the dissolution of gold by cyanide and its simultaneous adsorption by carbon take place essentially to completion in a stagnant pulp. Shortly thereafter, and as a result of the stagnant pulp experimental work, Winters and Chapman demonstrated that soluble gold, in a cyanide ore pulp, would migrate from the ore pulp through a perforated container and be adsorbed by carbon within the container.

During the same year, the Eagle-Picher Mining and Smelting Co. erected a 25-ton capacity pilot plant at the Harquahala mine about 9 miles from Salome, Ariz. Experimental work at this plant comprised chiefly the stagnant pulp modification of carbon-cyanidation although considerable work was done in the grinding and activation of carbon, and testing various methods of extracting adsorbed gold from carbon.

Soon after the completion of the Harquahala

---

* T. G. Chapman: A Cyanide Process Based on the Simultaneous Dissolution and Adsorption of Gold. *Trans.* AIME (1939) 184, 207.

E. H. CRABTREE, JR., Member AIME, is Director of Milling, Eagle-Picher Mining and Smelting Co., Miami, Okla., V. W. WINTERS is Superintendent, Sahuarita Concentrator, Eagle-Picher Mining and Smelting Co., Tucson, Ariz., and T. G. CHAPMAN, Member AIME, is Dean, College of Mines, University of Arizona, Tucson.

AIME San Francisco Meeting, February 1949.
TP 2744 B. Discussion (2 copies) may be sent to Transactions *AIME before March 31, 1950. Manuscript received March 3, 1949.*

experimental work, the Eagle-Picher Mining and Smelting Co. erected a continuous, small capacity, pilot plant at its Sahuarita concentrator, about 20 miles from Tucson, Ariz., to continue experimental work with various modifications of carbon-cyanidation. This plant has operated almost continuously since this time.

At the conclusion of the war, the authors experimented with the Government war surplus, coarse gas-mask carbon. Several flowsheets employing such carbon were tried for the adsorption of dissolved gold from ore pulps including the stage addition and countercurrent movement of the carbon in pulps. Among these methods may be mentioned: (1) coarse carbon, ground to approximately 100 mesh was added to the ore pulp and separated from the pulp by flotation; (2) coarse carbon* was added to a stagnant ore pulp and separated from the pulp by screening; (3) coarse carbon was added to an agitated ore pulp and separated from the pulp by screening; and (4) perforated cylinders, containing coarse carbon, were placed in agitators and partially submerged into the ore pulps. The containers were slowly revolved for the adsorption of soluble gold and in a series of agitators the carbon, with or without the containers, was moved from agitator to agitator countercurrent to the flow of the pulp.

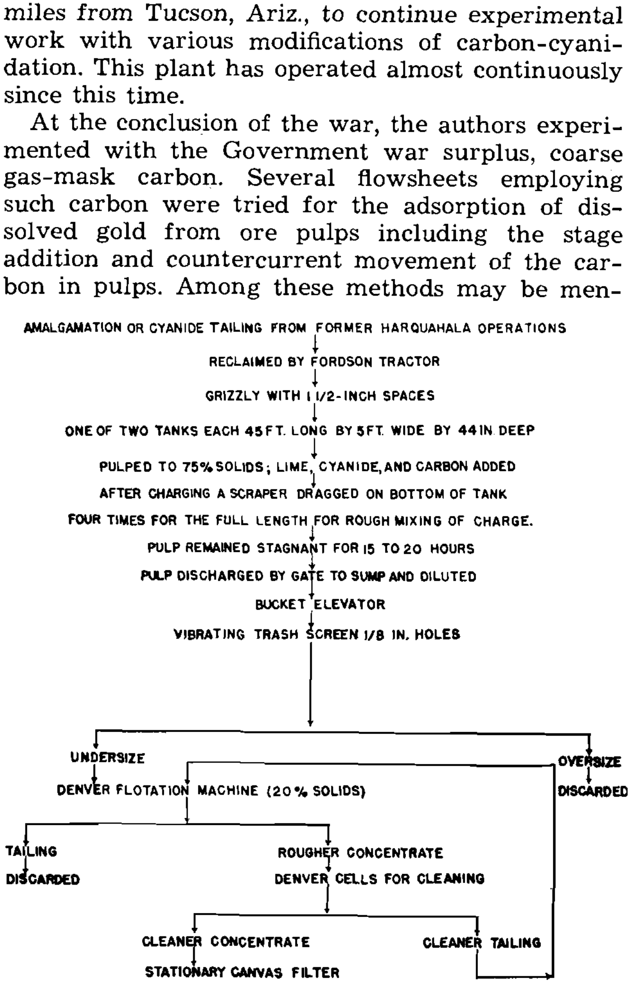

Fig. 1—Stagnant pulp modification, Harquahala pilot plant.

During the progress of the work involving the use of coarse adsorptive carbon it was realized by the authors that if such adsorptive material were to be employed on a commercial basis either a lower cost carbon than that available during the testing period must be provided or the problem of desorbing the gold from the carbon and the re-use of the carbon must be solved. Referring to the availability of a lower-cost coarse carbon, although considerable progress has been made in reducing the cost, insofar as the authors are informed, the cost of such carbon is still too high to warrant employing it once and destroying it by burning for the recovery of its adsorbed gold. Recent work has demonstrated that carbon derived from ore pulps can be almost completely desorbed of its gold and silver and the carbon re-used for further adsorption.

It is believed, therefore, that a complete carbon-cyanide process, with several modifications, is now available which offers considerable promise from the standpoints of: (1) low capital cost of plant; (2) extractions, as compared to standard cyanide methods, are at least as high in the treatment of fast settling ores and higher in the treatment of clayey ores and some refractory ores; (3) the production of bullion without burning the carbon and smelting the resultant ash is feasible; (4) pregnant solutions resulting from desorption of carbon amount to only 10 to 15 tons per 100 tons of ore treated, thus greatly reducing the size of the gold precipitate unit; (5) a process which can treat slow-settling as readily as fast-settling ores; (6) the flotation modification recovers some forms of insoluble gold while floating the carbon and its soluble gold content; (7) during the last stages of adsorbing soluble gold it is not necessary to maintain free cyanide in the pulp whereas it is necessary to maintain free cyanide in solutions during conventional precipitation with zinc; (8) loss of efficiency in the adsorption stage due to foul solutions has not been encountered in carbon-cyanidation; (9) in the treatment of ores containing graphite or pyrrhotite, loss of soluble gold adsorbed on graphite and loss by premature precipitation by the decomposition products of pyrrhotite does not occur, at least not to the extent it does with standard cyanide methods; and (10) in the presence of certain cyanicides such as copper sulphide the stage addition of cyanide to maintain low concentrations of cyanide shows promise in reducing the consumption of cyanide.

The brief descriptions and data which follow have been taken from plant work completed since 1939 to indicate the progress which has been made with the various modifications of carbon-cyanidation.

Stagnant Pulp Modification: The Eagle-Picher Mining and Smelting Co., as previously mentioned, operated a 25-ton capacity pilot plant to confirm results which had been obtained in the laboratory in eliminating agitation during the dissolution of gold from an ore pulp by cyanide and its adsorption by carbon. The plant was erected at the Harquahala mine and operated on very slow settling clayey amalgamation or cyanide tailing from former operations. Fig. 1 gives a flowsheet of the Harquahala test plant. The reclaimed tailing was charged to one of two concrete tanks provided for the dissolving and adsorbing stages. Each tank was 45 ft long by 5 ft wide by 44 in. deep and held 25 tons of dry tailing as a pulp containing 75 pct of solids. The method of operating was as follows: The tailing was reclaimed and conveyed to a grizzly having 1½ in. spaces by a Fordson tractor equipped with Ferguson system hydraulic scraper control.

---

* The coarse carbon used for all methods described varied in size but usually was minus 10 plus 35 mesh.

To fill a tank, 32 scraper loads, conveyed a distance of 150 to 200 yards, were required. Water, lime, and cyanide were first added to the tank after which one-third of the tailing was charged and activated carbon added to the surface. Tailing was again charged until the tank was two-thirds full and more carbon added to the surface. The final charge of tailing was then added with the remaining carbon added to the surface. The grizzly, shown in fig. 1, with scraper attached was then pulled back and forth twice for mixing the charge. The charge then stood, without further agitation, for a period of 15 to 20 hr after which the pulp was discharged to a sump and reclaimed by a bucket elevator. The bucket elevator discharged onto a 4x5 ft vibrating trash screen with ⅛ in. holes and the undersize was treated in Denver flotation cells for the separation of the carbon and its adsorbed values from the pulp.

Lime, cyanide, and carbon were added to the charge at the rates of 0.4, 0.5, and 3.6 lb per ton of tailing, respectively. Soft or hard wood charcoal, ground to from 48 to 150 mesh and activated at the plant by heating to 1400°F and cooling without quenching, was used.

Approximately 4000 tons of this material were treated on an experimental basis. The heads assayed from 0.085 to 0.11 oz gold per ton. The extraction varied from 66 to 79 pct and the carbon flotation concentrate assayed from 16 to 23 oz gold per ton. Barren solutions varied from 0.0042 to 0.0005 oz gold per ton depending upon the fineness of grinding the carbon and its adsorptive efficiency.

Table I gives typical results obtained when minus 150 mesh carbon was used and indicates results obtained with proper fineness of grinding but with rather crudely activated carbon.

Table I. Harquahala Test Plant Results, Tanks 129 to 137 Inclusive.

	Tons	Assay, Oz Gold per Ton	Gold, Oz	Gold, Pct
Heads	189.0	0.089	16.739	100.0
Carbon concentrate	0.5744	21.76	12.499	74.7
Barren solution	756.0	0.0009	0.680	4.1
Tailing	188.4	0.019	3.560	21.2

The following observations are offered with respect to the stagnant pool method of carbon-cyanidation and its potential usefulness.

1. The speed of dissolving and adsorbing gold without agitation is much faster than might be expected and is explained by the lower concentration of soluble gold surrounding the carbon particles as compared to the concentration of gold in other parts of the pulp. Similar to the flow of water in a pipe due to a difference in pressure, ions will migrate in an ore pulp if a difference in concentration is maintained between two parts of the pulp. The continuous adsorption of gold by carbon maintains this difference in concentration.

2. The results given in table I were obtained when a proper size but a rather inferior, cheap activated carbon was used. Experience obtained at the Harquahala test plant indicated that it was difficult to float carbon coarser than 100 mesh especially in the more dilute pulp of the cleaner circuit.

3. Due to the imperfect mixing of the charge, the assay of barren solutions varied to a considerable degree. It is believed that a very short agitation period, say 10 to 15 min, after the reclamation of the pulp from the stagnant pool and before flotation, would equalize irregularities due to imperfect mixing and yield not only more uniform barren solutions but also lower value barren solutions.

4. Steam activated carbon would, no doubt, have yielded lower barren solutions than the crudely activated carbon employed at Harquahala. It is questionable, however, that the higher cost steam-activated carbon would have been better from the economic viewpoint at the time the tests were made.

5. There is a potential field of use for such a method of carbon-cyanidation in the leaching of gold from tailing piles in place. If mechanical methods can be devised to pulp the surface of such tailing piles to a consistency of, say, 75 to 80 pct solids the reactions of dissolving and adsorbing gold will, it is believed, take place without agitation.

Flotation Modification: Flowsheets for the modification of carbon-cyanidation employing finely ground carbon for adsorption and flotation for the separation of the carbon from the ore pulp have been published.[*] This method may be used with one or more stages of adsorption. With multiple stage adsorption the carbon is moved countercurrent to the flow of the ore pulp.

There are at least two advantages to this method as compared to other modifications. First, a soft, rather crudely activated wood carbon may be used as the increased surface of the finer carbon apparently nearly compensates for the crude activation and, second, some minerals which contain gold, insoluble in cyanide, may be recovered in the flotation carbon concentrate.

Adsorption With Revolving Screens Containing Carbon: A general flowsheet of this modification is given in fig. 2. It should be noted, however, that the flowsheet, as given in fig. 2, may be changed to meet the requirements of the specific ore to be treated.

G. H. Roseveare, of the Arizona Bureau of Mines, working with Chapman in the laboratories of the University of Arizona was the first, to the author's knowledge, to construct a horizontal, revolving-screen test unit attached to a laboratory mechanical-type agitator. A few months later Chapman and others did the experimental work involving the permissible volume of carbon in a screen and the size of screen required in mill operation. A 5x5 ft Wallace agitator and a 12x15 in. revolving screen were used for this work.

This modification differs from other modifications in that the steps of dissolving the gold, adsorbing the dissolved gold, and separating the carbon from the ore pulp are combined and take place as a continuous process in a single step. It should be noted that the combining of the three steps was described for a stagnant pulp and that the revolving screen only served to make the batch process of the stagnant pulp modification a continuous process. The

---

[*] T. G. Chapman: A Cyanide Process Based on the Simultaneous Dissolution and Adsorption of Gold. *Trans.* AIME (1939) 134, 207.

countercurrent movement of the carbon may be used as in other modifications.

Referring to fig. 2, the data presented in this paper for this modification were obtained without the classifier in the grinding circuit and without the thickener following the grinding circuit. The reason for these changes in the flowsheet was the use of Harquahala tailing for testing which did not require grinding or thickening. The Sahuarita test plant flowsheet included a 16 x 32 in. Denver ball mill operated with a light ball load for pulping the tailing. The mill was fed at the rate of 60 lb of dry tailing per hour pulped to 37 pct solids. The ball mill discharged to a 20-mesh vibrating trash screen and the screen undersize was pumped to the first of three 36 x 36 in. Wallace agitators placed in series. Agitators 1 and 2 were each equipped with one 28-mesh stainless steel screen and agitator 3 had two screens. The screens, 9¾ in. in diameter and 5 in. long, were revolved at 35 rpm and were submerged approximately 2½ in. into the ore pulp. Each agitator provided a detention time of 8 hr. The countercurrent movement of the carbon was accomplished by moving the screens at 3-hr intervals from agitator 3 to 2 and from agitator 2 to 1. The carbon on leaving agitator 1 was desorbed and the desorbed carbon was recycled to the screens of agitator 3.

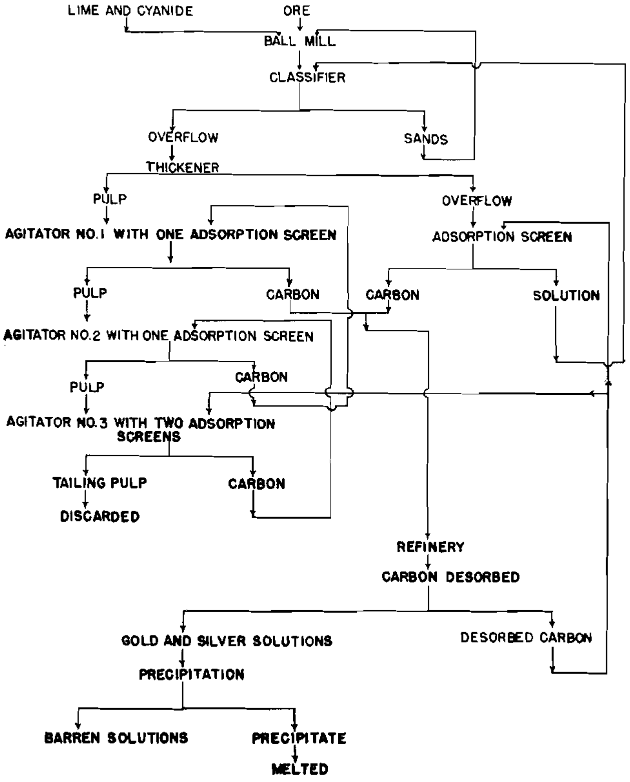

Fig. 2 — Adsorption by revolving screens containing carbon.

Lime, cyanide, and carbon were added at the rates of 0.73, 0.88, and 3.5 lb per ton of tailing treated respectively.

Table II gives the results of a 63-hr test with this flowsheet. The test was operated as described for 15 hr and for the remaining 48 hr a scavenging screen was added to the tailing launder. The tailing pulp was allowed to flow from the launder to the top of the revolving scavenging screen and a rounded depression in the launder permitted the screen some submergence in the pulp.

Table II. Container Modification, Results of 63 hr Test at Sahuarita Plant

	Weight, Lb.	Tons per 100 Tons of Heads	Assay, Oz Gold per Ton	Per Cent
Heads	3,780	100.0	0.096	100.0
Carbon	8.06	0.213	41.86[a]	92.7
Barren solution	6,426	170.0	0.0012[b]	2.1
Tailing	3,780	100.0	0.005	5.2

[a] Carbon assayed 29.7 oz silver per ton.

[b] Barren solution from agitator 3 averaged 0.0025 oz gold per ton.

Referring to table II the following comments are offered:

The barren solution given in the tabulation, namely, 0.0012 oz gold per ton, was the solution after treatment in the scavenging screen placed in the tailing launder. The barren solution from agitator 3 is given in footnote b as assaying 0.0025 oz gold per ton. The scavenging screen, with a very short time of contact with the tailing pulp, therefore reduced the assay of the barren solution from 0.0025 to 0.0012 oz gold per ton.

Desorption of Gold and Silver from Carbon: The desorption of gold and silver from a carbon that has been in contact with an ore pulp apparently depends upon the shifting of the equilibrium encountered between adsorption and desorption. Four methods of shifting the equilibrium succeeded in desorbing the gold and silver. The four methods comprised: (1) the use of a solvent in conjunction with a large excess of precipitant in order to remove the gold from the receiving solution as the desorption progressed; (2) the use of a solvent in conjunction with electrolysis to accomplish the same purpose; (3) the use of a solvent and large volumes of solutions, added in stages, to keep the concentrations of the gold and silver in the receiving solutions sufficiently low to accomplish desorption; and (4) the use of higher temperatures by employing hot solvent solutions in a pressure chamber. The authors believe that the last method given is the most feasible as this method is very rapid, has the lowest reagent cost, and accomplishes the desorp-

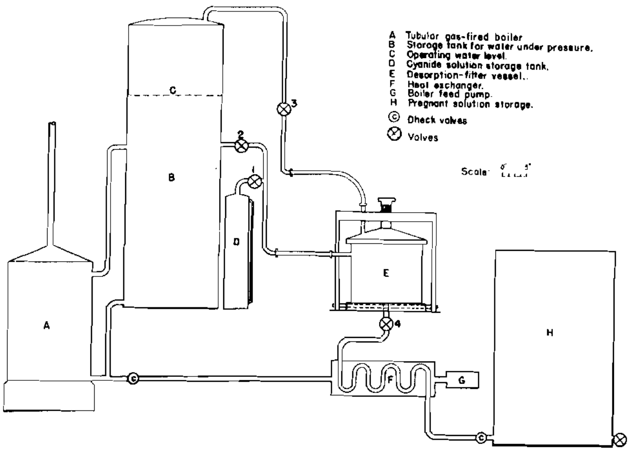

Fig. 3—Desorption equipment.

tion with the minimum volume of desorbing solution.

Fig. 3 gives the equipment, designed and constructed by Winters at the Sahuarita plant, for this method of desorption. The equipment consisted of a 1 hp, gas-fired, vertical fire-tube boiler *A*, and a hot water pressure storage tank *B*. The desorption was accomplished in the quick opening pressure filter *E*. Heat exchanger *F* and pregnant solution storage tank *H* completed the essential equipment.

The operating cycle comprised placing the carbon in the filter *E* and adding cyanide solution to the filter from tank *D* through valve *1*. Hot water was then added from *B* through valve *2* after which valve *2* was closed and valve *3* opened, which subjected the charge to the full boiler steam pressure of 90 to 95 psi. The cyanide used for each desorbing stage varied from 2 to 20 lb of 90 pct sodium cyanide per ton of carbon treated and the hot water for each desorbing stage amounted to 10 tons per ton of carbon. The soaking period was 20 min after which the closing of valve *3* and the opening of valve *4* forced the pregnant solution through the filter in *E*, through the heat exchanger *F* and into the pregnant solution storage tank *H*. The pipe which discharged the hot pregnant solution into *H* was kept submerged by solution constantly maintained in *H* to prevent flashing. Five cycles as described were used for each charge of carbon.

Table III. Desorption of the Carbon of Table II

	Carbon, Lb	Tons per 100 Tons of Mill Heads	Assay, Oz per Ton		Per Cent	
			Gold	Silver	Gold	Silver
Heads, carbon, screens 11 to 31	8.06	0.213	41.86	29.7	100.0	100.0
Pregnant solution	466.	12.32	0.68	0.48	98.4	100.0
Desorbed carbon	8.06	0.213	0.63	Trace	1.6	0

Table III gives the data for the desorption of the carbon used in the 63 hr test of Table II.

Referring to Table III, the desorption of the gold was 98.4 pct and the desorption of the silver was essentially complete. The volume of the pregnant gold and silver solution, including the diluting water added to the pregnant gold solution storage tank to prevent "flashing," amounted to 12.32 tons per 100 tons of ore treated which is equivalent to 57.8 tons of pregnant solution per ton of carbon desorbed. The pregnant solution assayed 0.68 oz of gold and 0.48 oz of silver per ton. If the pregnant solution storage tank was operated on a continuous basis, as would be the case in practice, dilution to avoid flashing would not be necessary and the volume of the pregnant solution would be 10.65 tons per 100 tons of ore treated and 50 tons per ton of carbon desorbed.

Assuming an average settling ore with average size of grinding treated by countercurrent decantation, the volume of pregnant solution for precipitation would amount to approximately 300 tons per 100 tons of mill heads. The solution precipitated by standard cyanide methods would therefore be approximately 28 tons as compared to one ton of solution produced by the desorption of carbon.

The desorption of the activated petroleum coke used in this test was not as complete as that obtained with shell carbon as given in table IV. In table III the percentage of gold desorbed was 98.4 for the petroleum coke as compared to an average desorption of 99.5 pct for shell carbon.

Cyanide was added for the test described at the rate of 2 lb per ton of carbon per cycle or a total of 10 lb of cyanide per ton of carbon. With other carbons it was necessary to add greater amounts of cyanide. Tests to determine minimum cyanide requirement for a given carbon have not been made to date.

The maximum capacity of the 10 x 12 in. desorption chamber shown in fig. 3 has not been determined. As operated in tests described in this paper one charge of carbon amounted to 2.22 lb and five 20-min soaking periods were used per charge. Assuming a total time of 2 hr for desorption the capacity would be 26.6 lb of carbon per 24 hr. This amount of carbon would be obtained from the treatment of approximately 7.5 to 9 tons of low grade ore. The soaking time per cycle can undoubtedly be decreased so that the capacity given is probably low.

Comparison of Desorbing Petroleum Coke and Shell Carbon: Table IV gives the comparative results of desorbing activated petroleum coke and

Table IV. Desorptions of Petroleum Coke and Shell Carbon Compared

Nos. of Screens[a] for Adsorption	Kind of Carbon	No. of Previous Desorptions	Wt. of Carbon Desorbed, Gram	Assays of Carbon Heads to Desorption, Oz per Ton		Assays of Desorbed Carbon, Oz per Ton		Per Cent Desorbed	
				Gold	Silver	Gold	Silver	Gold	Silver
16 to 22 incl.	Petroleum coke	None	1,008	42.76	33.6	0.32	None	99.2	100.0
23 to 29 incl.	Petroleum coke	57 pct fresh, 43 pct desorbed once	1,008	39.76	19.2	0.46	None	98.8	100.0
11 to 15, 30, 31	Petroleum coke	70 pct fresh, 30 pct desorbed once	1,008	43.07	37.2	1.12	None	97.4	100.0
40 to 44 incl.	Shell-Sahuarita activated	None	720	55.44	53.8	0.24	None	99.6	100.0
45 to 49 incl.	Shell-Sahuarita activated	None	720	41.01	49.4	0.136	0.55	99.6	98.9
50 to 56 incl.	Shell-factory activated	None	1,008	40.71	70.6	0.238	2.6	99.4	96.3
65 to 67 incl.	Shell-factory activated	1	432	46.33	52.6	0.27	0.68	99.4	98.7

[a] The screen numbers refer to the screens used for adsorption in the container modification (see fig. 2 and table II), and are given only to identify the carbons used for desorption.

Table V. Recycling of Desorbed Carbons

Nos. of Screens[a]	Time of Test, Hr	Kind of Carbon	New, Desorbed, or Reactivated Carbon Used	Assay of Carbon, After Adsorption, Oz per Ton		Barren Solution Assays, Oz per Ton			
						After Third Agitator		After Scavenging Screen	
				Gold	Silver	Gold	Silver	Gold	Silver
11 to 26	48	Petroleum coke	New, factory activated	43.72	30.5	0.0022	0.007	0.0010	0.004
27 to 33	21	Petroleum coke	Screen 11 to 26 desorbed	37.15	29.4	0.0036	0.010	0.0018	0.006
34 and 35	6	Petroleum coke	Screens 27 to 33 desorbed	36.44	40.4	0.0042	0.010	0.0020	0.005
36 to 39	12	Petroleum coke	Desorbed twice, Sahuarita reactivated	44.35	65.5	0.0032	0.012	0.0011	0.006
40 to 49	30	Shell carbon	New, Sahuarita activated	48.22	51.6	0.0025	0.011	0.0009	0.006
57 to 64	24	Shell carbon	Screens 40 to 49 desorbed	31.37	38.2	0.0028	0.012	0.0014	0.008
50 to 56	21	Shell carbon	New, factory activated	40.71	70.6	0.0017	0.007	0.0008	0.005
65 to 67	9	Shell carbon	Screens 50 to 56 desorbed	46.33	52.6	0.0035	0.013	0.0020	0.010

[a] The screen numbers refer to the screens used for adsorption in the container modification (see fig. 2 and table 11), and are given only to identify the carbons used.

shell carbon. The average desorption of gold and silver from petroleum coke was 98.5 and 100 pct, respectively, as compared to 99.5 and 98.5 pct for shell carbon.

Although the results given in Table IV show some increase in the assays of the desorbed residues for the second desorption of the same lot of carbon, the increase is not serious and the repeated desorptions of other carbons, not reported in this paper, did not indicate any build up of gold and silver in the residues after repeated desorptions.

Table V gives a comparison of barren solutions and assays of carbon obtained when freshly activated, desorbed, and desorbed reactivated carbons were employed for adsorption in the container modification.

Referring to the barren solutions, two barren solutions are included in the tabulation. The first is the solution discharged from the third agitator, and the second, the solution leaving the scavenger screen of the tailing launder. The figures in the tabulation show an increase in gold content of the barren solution with petroleum coke and shell carbon in the recycling of the desorbed carbon without reactivation. With petroleum coke, the fresh activated carbon yielded a barren solution of 0.0010 oz gold per ton after the scavenging screen, a barren solution of 0.0018 oz with the recycling of the carbon after one desorption, and a barren solution of 0.0020 oz with the recycling of the carbon after two desorptions. The ratio of solution to solids leaving the scavenger screen was 1.7 to 1. With the reactivation of the carbon, however, after two desorptions the barren solution was reduced to 0.0011 oz. The data in the tabulation is not as complete for the shell carbon but does show an increase in the assay of the barren solution with recycling after one desorption.

The assay values of barren solutions depend not only upon the adsorptive efficiency of the carbon but also upon the kind and length of contact of the carbon with the ore pulp. For example, comparing the barren solutions of the third agitator with those of the scavenging screen it is noted that improved contact between the carbon within the screen and the ore pulp drastically reduced the barren solution loss.

Although the data show that desorbed carbon, which has not been reactivated, has decreased adsorptive speeds it is entirely possible that more effective contact with such carbon will make up to a considerable degree for the loss of adsorptive speed for such carbons. The data indicate that the reactivation of desorbed carbon restores its adsorptive speed to that of fresh carbon.

The authors believe that the loss of adsorptive speed of a desorbed carbon as compared to a fresh carbon is due to the partial filling of the interstitial spaces of the carbon by slime. The reactivation of desorbed carbon, which apparently restores its adsorptive speed, is believed to increase the interstitial spaces by oxidation with steam during reactivation.

Summary: This paper describes the use of the carbon-cyanidation process in a stagnant ore pulp in a pilot plant having a capacity of 25 tons per day. Minus 150-mesh activated carbon, with lime and cyanide, were pulped with gold-bearing tailings residues at a consistency of 75 pct solids and allowed to stand for a period of 15 to 20 hr. The carbon was then recovered from the diluted pulp by flotation. About 75 pct of the gold was recovered in the carbon flotation concentrate.

Another method using coarse activated carbon in revolving screen containers partially immersed in a series of three agitators recovered 92.7 pct of the gold in a coarse carbon concentrate assaying 41.86 oz of gold per ton of carbon. This concentrate was then treated by a desorption method described in which 98.4 pct of the gold was extracted in a pregnant solution assaying 0.68 oz of gold per ton of solution. The volume of this solution amounted to only 12.32 tons per 100 tons of ore treated. The desorbed carbon was re-used in succeeding tests.

Comparative desorption tests on activated petroleum coke carbons and shell activated carbons indicated that gold desorption of the shell was slightly better, reaching as high as 99.6 pct of the gold. Tests indicated that the adsorptive efficiencies of the carbons after desorption were not quite as good as originally, but that after two desorptions followed by reactivation, the adsorptive speed was practically restored to that of fresh carbon.

Further work is required to determine just how many times the carbon may be re-used.