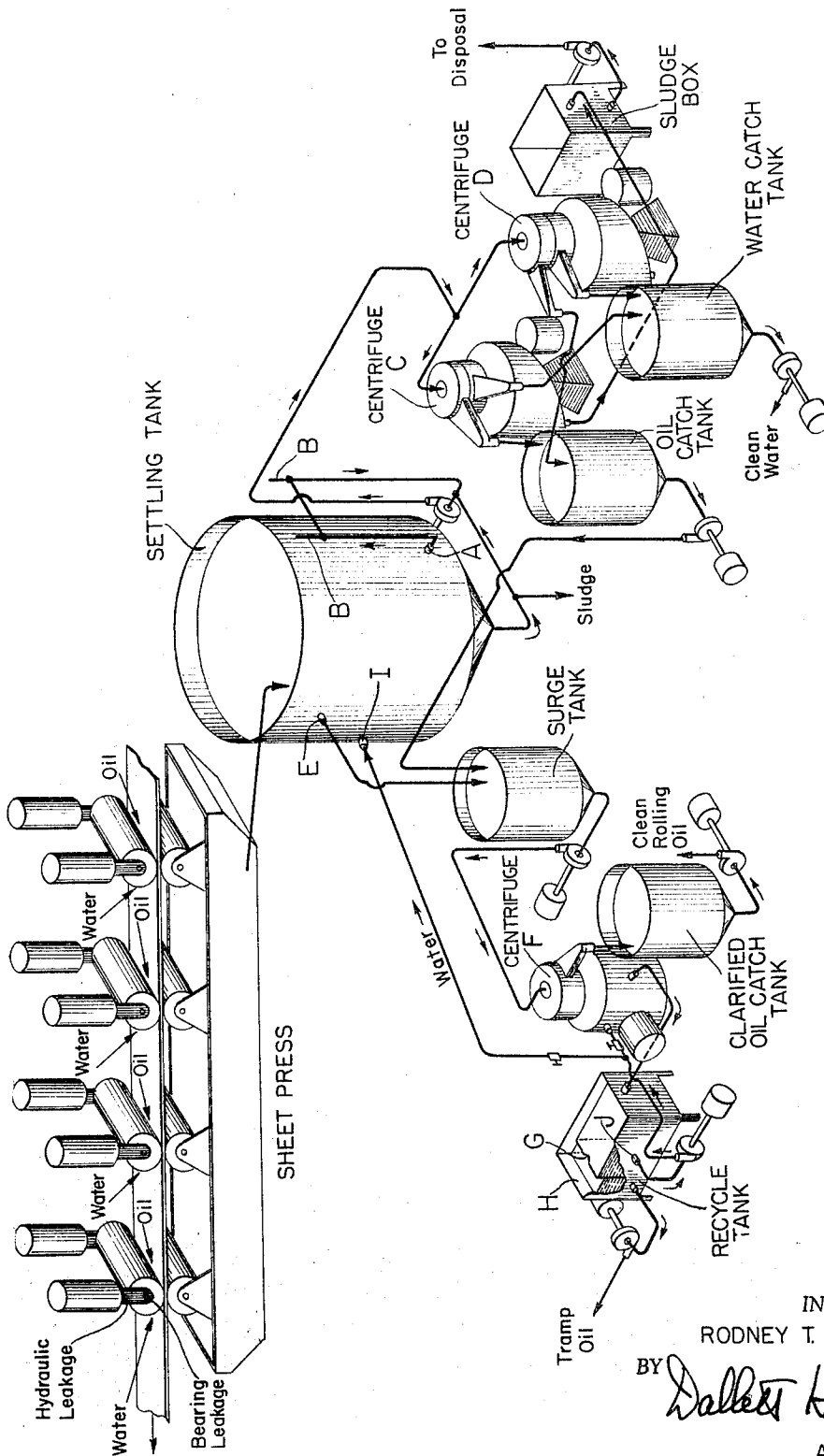


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3,265,212 PROCESS FOR THE PURIFICATION OF ROLLING MILL OIL

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3 Claims. (Cl. 210-73)

This invention relates to a process for the purification of rolling mill oil. More specifically, this invention relates to the removal from rolling mill oil of mill coolant water, tramp oil, and insoluble impurities, such as dirt, dust, iron oxide and carbon.

In the manufacture of continuous sheet steel or other metals, it is conventional to "cold roll" a continuous strip of the metal by passing it through a series of press rolls, each pair of rolls pressing the strip into a longer, thinner sheet. By such an operation steel sheet having a thickness of .003 to .004" may be produced, the end product being useful, for instance, in the fabrication of "tin" cans. To cut down the friction involved in the rolling operation, to avoid sticking, to avoid heat build-up, and to carry off oxides and dust, it has been customary to spray the metal entering the nip of each pair of rolls with an expensive compounded lubricating or rolling oil. To further cool the operation in a so-called "direct application" procedure, the thinner sheet emerging from the rollers is sprayed with large quantities of water.

It has been customary as shown in the prior art to collect the mixture of rolling oil and coolant water in a pit or trough underneath the press rolls and convey it to a settling tank, the lighter oil subsequently being pumped off and returned to the mill for reuse. The settled water has also been reused or in situations in which water has been in plentiful supply has been discarded. A prior art example of such a process is disclosed in Patent 2,140,289 to Hurtt et al., which issued December 13, 1938.

A heretofore unavoidable problem connected with such clarification has been the leakage into the system of relatively small quantities of "tramp" oil. Tramp oil is a generic name applied to oil used to lubricate the bearings of the press roll and also used in the pressure cylinders of the rolls. The tramp oil, invariably of a petroleum base, has found its way into the rolling oil-coolant water system, usually by simply dropping downward into the pit or trough beneath the rolls. Being of light weight it has in the past settled with the rolling oil and has been withdrawn with the rolling oil and returned to the mill for reuse. The tramp oil is itself dark in color and in contact with dirt, etc. in the rolling operation becomes darker with each reuse. As a consequence tramp oil applied with the rolling oil has caused blotches and stains and imperfections on the surface of the sheet product.

Rather than risk a poor product, metal processors have been forced to completely dispose of their rolling oil at frequent intervals and have replenished the system with fresh oil at great expense.

In addition to contamination with tramp oil, the rolling oil will after a short period of use contain the usual insoluble contaminants—dirt, dust, iron oxide and carbon—the presence of which is serious and to be avoided. A portion of the insoluble contaminants are of such size that they are easily settled in the pit and removed from the system as sludge. On the other hand some of the solids are fine and heretofore have been virtually impossible to remove.

It is a feature of the present invention to remove portions of the tramp oil and keep its presence in the rolling

mill system down within a tolerable limit without undue loss of rolling oil.

It is a further feature of this invention to remove from the rolling mill system fine insolubles which are difficult to settle and which otherwise would be returned to the rolls with the rolling oil.

Other features of the invention will be apparent to those skilled in the art upon reference to the following description of a preferred embodiment of the invention, with further reference to the drawing which is a diagrammatic perspective view of a process embodying the invention.

As represented diagrammatically in the figure, at the sheet press a number of pairs or stands of cooperating rolls work successively on the sheet. Each pair of rolls may comprise a bottom or back-up roll positioned under the sheet and an upper roll or work roll pressed toward the lower roll by a hydraulic ram to develop pressure against the sheet between the rolls. The rolls, of course, are mounted on bearings which are provided with lubrication by means not shown. The lubricating oil from the bearings and the hydraulic fluid from the rams comprise the source of tramp oil with which the invention is concerned. As also indicated diagrammatically in the figure roller oil is sprayed against the sheet as it enters the nip of each pair of rolls. Coolant water is sprayed as the sheet emerges from each pair.

Positioned below the press is a rectangular pit adapted to collect the used rolling oil, the mill coolant water, insolubles and the tramp oil. In actual installation such a pit is of ample area to underlie all portions of the operation from which the above-mentioned liquids may fall and thus serves effectively to collect them.

As shown in the figure the mixture of rolling oil, mill coolant water and tramp oil is conducted from the pit to a large settling tank (for instance, of 10,000 gallon capacity) and it is in this settling tank that the collection commences to settle in accordance with the specific gravity of its various portions. For instance at the lower end of the tank the heavy solids will accumulate so that they may be drained and let off as the sludge discharge from the system. Above the sludge in the settling tank will be an indefinite layer of coolant water emulsified with the rolling oil, the proportion of oil becoming greater as the top of the tank is approached. Throughout the emulsion there will be fine solids which because of their small size are slow in settling. Adjacent the top of the settling tank collection will be a layer of rolling oil which has not been emulsified with the coolant water.

After the collection has been allowed to remain in the tank undisturbed for some time after start-up (for instance 30 minutes) the centrifugal separation of the collection into its various components may commence and may operate on a continuous basis thereafter. As shown, liquid from a point A adjacent the lower end of the settling tank but above the sludge layer is drawn off, passed by a pair of vents at B to permit escape of entrapped gases and pumped along with portions of the sludge discharge if necessary or desired to a pair of centrifuges C and D disposed in parallel. This liquid may comprise, for instance, 15% oil and 85% water.

Centrifuges C and D are similar, both being of the type comprising a solid bowl having peripheral nozzles and a pair of coaxial ring dams over which the lighter oil and the heavier water discharge respectively. Such centrifuges are available from The Sharples Corporation under the trademark "Nozljector" centrifuge. Each of the centrifuges preferably contains a stack of frusto-conical discs within which the interface between the two liquids, oil and water, is appropriately maintained. Thus the zone of greatest separating efficiency, the disc stack,

works the most difficult portion of the stubborn emulsion, breaks it and separates it into its two components. As shown the ring dam discharges from the centrifuges C and D are respectively collected together in a water catch tank which collects the liquid from the outer ring dam of each machine and provides a water discharge for the entire system; and an oil catch tank collects the inner ring dam discharges. For greatest efficiency in the process the position of the interface within the machines C and D is controlled so that the water discharge is virtually free of any oil while the oil discharge may have some degree of wetness. In other words, at this stage in the process the concern is more in discharging an oil-free water than a water-free oil.

The nozzle discharge of the centrifuges C and D is solids and water and is collected in the sludge box shown at the right-hand side of the figure and settled prior to disposal.

From the oil catch tank liquid is pumped as shown to a surge tank. Also delivered to the surge tank is a discharge from a point E adjacent the upper end of the settling tank and containing rolling oil in which there is a lesser degree of water than might be found in the emulsion at a lower point in the settling tank. From E, for instance, the drawoff may be 15% water and 85% rolling oil.

From the surge tank the flow which is rolling oil with small amounts of water is conducted to a centrifuge F. In the preferred form of the invention centrifuge F is in the form of a solid wall centrifuge having peripheral nozzles and a single ring dam discharge from which the clarified rolling oil may discharge. Also provided in the centrifuge is an underflow arrangement by which a supplemental liquid may be delivered to the inside of the bowl adjacent the peripheral wall. Such a centrifuge is thoroughly disclosed in the U.S. Patent 3,047,214 which issued July 31, 1962 on an application by Francis P. Downing. In the present process the underflow is provided from a recycle tank as shown to which is delivered the nozzle discharge of centrifuge F. The nozzle discharge will contain, of course, a high percentage of water with some solids and it is part of this water which is returned to the machine as underflow to satisfy the demands of the centrifuge nozzle or peripheral openings without permitting passage therethrough of the lighter rolling oil. It is by this means that the interface between the aqueous and rolling oil phases may be located adjacent the periphery of the centrifuge bowl outside the disc stack without danger of losing the valuable rolling oil to the aqueous nozzle discharge. Such a machine which greatly accounts for the efficiency of the process is available from The Sharples Corporation under the trademark "Gravitrol" centrifuge.

The ring dam discharge from the centrifuge F is delivered to a clarified oil catch tank and is drawn off to comprise the clean rolling oil discharge for the system. It is returned to the press and reapplied to the sheet as it enters each pair of rolls.

As shown, the recycle tank includes an upward vertical partition G over which the lightest layer may fall into a separate compartment H. The water from the larger compartment of the recycle tank is not only delivered back to centrifuge F to satisfy the nozzles, but also a portion of this water is delivered back to the settling tank at a point I preferably intermediate points A and E for reprocessing. This water, since it comes from a point J spaced above the bottom wall of the recycle tank, may contain some oil.

From adjacent the bottom wall of the compartment H of the recycle tank the liquid which overflowed the partition G is led off. This liquid, upon analysis, contains to a large percentage tramp oil which as noted above originated from the bearing and hydraulic leakage for the press. The tramp oil discharge not only contains a high percentage of the undesired tramp oil but many

of the fine solids which appeared through the settling tank. The tramp oil discharge together with the solids of fine size may be sent to disposal.

The appearance of the tramp oil in the recycle tank is surprising. One would expect that having once mixed with the rolling oil of the mill it could not be separated therefrom under any circumstances. However, it consistently appears in the heavy discharge from the centrifuge F and in an actual installation the output of rolling oil has reached an equilibrium with only 1% tramp oil contamination. This small amount of contamination is entirely tolerable to the processor.

The reason for the appearance of the tramp oil with the aqueous discharge from the centrifuge F is not known. It is believed, however, that the tramp oil being mineral-based is not soluble in the normally fatty-oil-containing rolling oil-coolant water emulsion which it meets during the rolling operation. Being an oil-phase the tramp oil moves in to selectively wet the finer insolubles in the system and to comprise what may be regarded as a lighter solids phase. This solids phase, as distinguished from the rolling oil—mill coolant light emulsion which behaves like an aqueous phase, retains its identity and during the final clarification moves out with the water in a split off from the rolling oil.

A rolling oil may comprise a preponderance of fatty-based oils with virtually no petroleum distillates. Alternatively, rolling oil may comprise a mixture containing 50% of a petroleum distillate with the remaining portion a mixture of fatty-based oil such as palmitic and a non-ionic emulsifier. The emulsifier gives to the mixture the qualities of a homogeneous phase. Tramp oil, on the other hand, as stated, is a petroleum-based product.

Other explanations for the success of the system are possible. It is sufficient to acknowledge, however, that by the arrangement of the invention the amount of tramp oil returned to the mill may be kept within tolerable limits. Just as important, with the tramp oil are removed insoluble impurities. These impurities would otherwise be returned to the mill and ultimately affect the quality of the mill product.

It should be understood that reasonable variations from the process shown are contemplated within the limits of the appended claims. Where pumps are shown in the drawings, simple gravity delivery or other means of conveyance may be substituted. Further, the use of a single centrifuge of the same or comparable type may be made in place of the parallel centrifuges C and D. Also to facilitate the initial stratification which takes place in the settling tank as shown, simple cyclones may be employed, for instance, as a pair in series with the light discharge of the first cyclone comprising the discharge E and the heavy discharge being delivered under pressure to the second cyclone along with recycle which appears at point I in the figure. The light discharge from the second centrifuge may comprise the discharge found at point A in the figure while the heavy discharge may be the bottom sludge discharge of the settling tank. Thus many variations of the preferred process are possible.

In other words, having particularly described the invention, it is to be understood that this is by way of illustration, and that changes, omissions, additions, substitutions, and/or other modifications may be made without departing from the spirit thereof. Accordingly it is intended that the patent shall cover, by suitable expression in the claims, the various features of patentable novelty that reside in the invention.

I claim:

1. In a rolling mill operation a process including the steps of collecting coolant water and rolling oil together with lesser quantities of tramp oil, stratifying the collection substantially according to the density of the components, withdrawing a heavier portion of the stratified collection and subjecting it to a locus of centrifugal force, discharging from adjacent the axis of the locus an oil-

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containing portion and from an outer region of the locus a coolant water discharge for the process, withdrawing a lighter portion of the stratified collection, combining it with the oil-containing portion and subjecting it to a second locus of centrifugal force, withdrawing from adjacent the axis of the second locus of centrifugal force a clean rolling oil discharge for the process, withdrawing from an outer region of the second locus a mixture of water and tramp oil and settling said mixture, withdrawing from the settled mixture a lighter portion comprising the tramp oil discharge for the process, and returning at least a portion of the clean rolling oil discharge for the system to the mill for reuse.

2. A process as described in claim 1 wherein the mixture of water and tramp oil is withdrawn through openings in the periphery of the second locus, and including the additional steps of withdrawing from the settled mixture a water component and returning it to the second locus of centrifugal force adjacent the periphery thereof to satisfy the demands of the openings so that no rolling oil escapes through the openings.

3. A process as described in claim 2 wherein the interface in the second locus between the oil and the water is adjacent the periphery of the locus.

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