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(54) Benævnelse: **SYSTEM OG FREMGANGSMÅDE TIL PRODUKTION AF ALFA-TYPE-GIPS VED ANVENDELSE AF VARMEGENVINDING**

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GB-A- 2 213 810
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US-A- 4 117 091
US-A- 4 820 053
US-A- 4 890 394
US-A- 5 013 237
US-A- 5 659 975
US-A1- 2004 011 038
US-A1- 2005 188 898
US-B1- 6 251 979
US-B1- 6 438 939

DESCRIPTION

Field of the Invention

[0001] This invention relates to a system and method for the production of gypsum in a plant. More particularly, the present invention relates to recovering heat at various locations within a board manufacturing plant and using the recovered heat to reduce the energy needed for subsequent calcination.

Description of the Background Art

[0002] It is known in the art to calcine gypsum in the manufacture of plasters, stuccos, gypsum wallboards and other building materials. However, the plants that produce gypsum-based building materials tend to be extremely inefficient users of energy as large amounts of energy are needed to adequately dry gypsum. For instance, some processes require 60 lbs. of water to be evaporated for every 100lbs of gypsum produced.

SUMMARY OF THE INVENTION

[0003] It is therefore one of the objects of the present invention to manufacture alpha-type gypsum in an energy efficient manner.

[0004] Another objective of the present invention is to remedy the inefficiencies inherent in the production of gypsum-based building materials.

[0005] It is also an object of this invention to provide a process for the production of gypsum building materials wherein heat generated from the drying of gypsum-based building materials is recovered and used for calcination.

[0006] Still another object of this invention is to provide a process wherein heat can be recovered at multiple locations throughout a building material plant and used in calcination.

[0007] The foregoing has outlined rather broadly the more pertinent and important features of the present invention in order that the detailed description of the invention that follows may be better understood so that the present contribution to the art can be more fully appreciated. Additional features of the invention will be described hereinafter which form the subject of the claims of the invention.

[0008] According to the present invention there is provided a system for the production of alpha type gypsum as claimed in the accompanying claims.

[0009] Also according to the present invention there is provided a method for the production of alpha type gypsum as claimed in the accompanying claims.

[0010] With reference to Figure 1, the construction of board dryer 22 is well known to those skilled in the art of manufacturing gypsum board. Typical dryer construction includes one or more conveyer belts for transporting boards from an inlet to an outlet. The inlet can be associated with one or more additional conveyors for use in carrying out additional manufacturing steps. For example, the boards may be cut to a desired size or shape and thereafter transported to the inlet of dryer 22. Likewise, additional conveyors can be associated with the outlet of dryer 22 for downstream processing of the boards. This additional downstream processing may include, for example, board coating and/or packaging steps.

[0011] Heating within dryer 22 can be accomplished via direct injection from gas burners. The heat from these burners can be diluted with recirculated gas so that the temperature within the dryer will be within the approximate range of 115°C to 195°C, depending upon the zone. The internal temperature of dryer 22 can be maintained by insulating dryer 22 using known techniques. Dryer 22 preferably includes a series of stages that allow for the progressive drying of the boards. The embodiment depicted in Figure 1 includes three such stages 22(a), 22(b), 22(d). Each of the dryer stages includes a corresponding chimney or stack 24(a), 24(b) and 24(c). The stages may likewise include separate heaters (not shown).

[0012] By way of this successive heating, the boards passing through dryer stages 22(a), 22(b) and 22(c) are heated to a degree sufficient to evaporate any excess moisture within the boards. Stacks 24(a), 24(b) and 24(c) permit this excess moisture to be removed from dryer 22 as steam. In a multi-zone dryer, such as the one depicted, most of the moisture will be removed in the final zone 22(c), and most of the steam will exit dryer 22 through the final stack 22(c). Once the boards exit dryer 22 they are cooled and transported for additional processing.

[0013] Steam leaving stacks 24(a), 24(b) and 24(c) will have a temperature of anywhere between 115°C to 195°C, and more often this steam will be within the range of 148°C to 195°C. In accordance with the present invention, both the latent and sensible heat from the steam is captured via a condenser 26 and used to calcinate raw gypsum into an alpha-type gypsum. Although a condenser can be associated with each of the stacks (24(a), 24(b), and 24(c)) of dryer 22, the preferred embodiment utilizes just a single condenser that is operatively connected to primary stack 24(c). This design is a reflection of the fact that most of the vapor, and thereby most of the heat, will escape from dryer 22 via the primary stack 24(c).

[0014] Condenser 26 can employ any of a number of different and widely known constructions and can be, for example, either an air cooled or liquid cooled condenser. The construction includes a heat exchanger (for use with an air cooled condenser) or coils (for use with a liquid cooled condenser), either of which are thermodynamically coupled to stack 24. With a liquid cooled condenser, a cooling medium, such as water or any of a number of commonly known refrigerants, is circulated through the coils via a pump (not shown). By bringing the cooling medium into thermodynamic contact with the steam, the overall temperature of the exiting steam is reduced. By reducing the temperature of the steam at least a portion of the steam is converted from the vapor phase to the liquid phase. This liquid phase is a hot condensate with a temperature within the approximate range of 82°C to 94°C, although the temperature of the condensate can be as high as 99°C. These temperatures are provided only as an example, as the exact temperature of the condensate will depend upon a number of factors, such as the temperature and quantity of steam leaving the stack, the construction of the condenser and the type of working fluid utilized. Condensate from condenser 26 is then collected and routed via pipes to mixing vessel 28.

[0015] With continuing reference to Figure 1, mixing vessel 28 is a collection point for raw gypsum, moisture and condensate from condenser 26. A stirrer 32 is included in order to sufficiently blend these components within the vessel 28. In the preferred embodiment, there is a 50 : 50 ratio by weight between the moisturized gypsum, on the one hand, and the condensate on the other. It has been found that this weight ratio produces a slurry with a consistency that is beneficial for further processing. Additionally, as a result of the increased temperature of the condensate that is added to tank 28 (e.g. between 82°C to 99°C), the resulting slurry mixture has a temperature within the approximate range of 60°C to 72°C. Again, however, these temperature ranges are provided as a representative example as the exact ranges will depend upon a variety of factors. The heated slurry is then transported to autoclave 38 for further processing.

[0016] Autoclave 38 can be any of a number of standard autoclave designs that are commonly used in wet or slurry type calcination. Autoclave 38 is a sealed vessel that includes stirrers 40 and a steam inlet. The internal pressure and temperature of autoclave 38 are increased via steam sparging. By heating raw gypsum within autoclave 38, typically to a temperature of about 138°C, calcination is carried out in accordance with the following equation: $CaSo_4 \cdot 2H_2O$ + heat = ($CaSo_4$ ½ H_2O) + 1.5 H_2O. Thus, as is well known in the art of gypsum processing, calcination converts calcium sulfate dihydrate into a calcium sulfate hemi-hydrate. Furthermore, carrying out the calcination under pressure yields an alpha-type calcium sulfate hemi-hydrate. Alpha-type plaster has a high mechanical strength with a compact crystal structure and low water demands. Thus, use of alpha-type plaster is sometimes preferred for building materials because it yields hard, low porosity casts.

[0017] By first heating the slurry in mixing tank 28, autoclave 38 only needs to raise the slurry temperature from the starting temperature of 60°C to 72°C to the calcinating temperature of 116°C. By contrast, using an unheated slurry would require heating the slurry within autoclave 38 from a starting temperature of approximately 15°C to the calcinating temperature of 116°C. This is the energy savings realized by recapturing the latent and sensible heat from dryer 22. The processed alpha-type gypsum is then removed from autoclave 38, via exit 42 and valve 43, for further processing, such as with a hydroclone separator 48 or belt filter 52 (note Figures 2 and 3). Thereafter, the processed gypsum can be incorporated into the gypsum based building materials, such as wallboards, using known techniques.

[0018] In still yet further embodiments of the present invention, described in conjunction with Figures 2 and 3, additional heat recovery is utilized to further increase the temperature of the slurry delivered to autoclave 38. This additional heat recovery generates an even greater energy savings during calcination. In the embodiment of Figure 2, the processed gypsum from autoclave 38 is delivered, via pressure let down valve 44, to a flash tank 46. Flash tank 46 permits the alpha gypsum slurry to cool and depressurize. Steam generated by the gypsum within flash tank 46 is collected and routed to condensate scrubber 56

via conduit 58. The collected steam within scrubber 56 is then condensed via slurry from mixing tank 28. More specifically, slurry from tank 28 is routed to scrubber 56 via a sprayer where it is used as a working fluid to further cool the captured steam and bring it into the liquid phase as a condensate. The result is a hot condensate that is delivered back to mixing vessel 28 via conduit 54. The additional heated condensate from scrubber 56 serves to increase the temperature of the slurry even further to an approximate range of 76°C to 88°C. Again, increasing the temperature of the slurry in this fashion yields substantial energy savings during subsequent calcination within autoclave 38. The alpha gypsum slurry within tank 46 is then removed via a pump for further processing by the hydro clone separator 48 and belt filter 52. All other components are the same as the primary embodiment of Figure 1.

[0019] It has been found that the energy required for taking the gypsum slurry from its normal temperature of 15°C to the starting point of 82°C represents two-thirds of the energy required to take the slurry from 15°C to 16°C. As a result, a substantial energy savings is realized by this additional heat recovery.

[0020] A still further energy savings is realized by even additional heat recovery. The alternative embodiment of Figure 3 illustrates a system wherein a portion of the gypsum slurry within tank 28 is routed to condenser 26 via a valve and conduit 62. This portion of the gypsum slurry is then utilized as the cooling medium in condenser 26, whereby the slurry is used to cool the steam leaving stack 24(c). The remaining slurry is removed from tank 28 via a valve for delivery to autoclave 38 for processing as described above. All other components are the same as the alternative embodiment of Figure 2. This embodiment results in an even greater energy savings as the slurry is used to bring the vapor into the liquid phase. This embodiment also eliminates the need for an independent cooling medium.

[0021] The present disclosure includes that contained in the appended claims, as well as that of the foregoing description.

Patentkrav

1. System til produktion af alfa-type-gips på pladefabrikker, hvor gipsen produceres ved anvendelse af varmegenvinding, hvilket system omfatter:
et pladetørreanlæg 22, der indbefatter et transportbånd og et varmeelement, hvor et antal gipsplader transporteres og opvarmes til derved fjernelse af overskydende fugt fra gipspladerne, hvilket pladetørreanlæg 22 indbefatter en eller flere skorstene 24 til muliggørelse af, at overskydende fugt fra gipspladerne kan fjernes fra pladetørreanlægget 22 som damp;
en kondensator 26, der er forbundet med en af skorstenene 24 på pladetørreanlægget 22, hvilken kondensator 26 anvender et kølemiddel til nedkøling af dampen i skorstenen til frembringelse af et opvarmet kondensat;
en blandingstank 28, der er i forbindelse med kondensatoren 26, hvor opvarmet kondensat fra kondensatoren blandes med rå gips til frembringelse en opvarmet gipsopslemning;
en autoklave 38, der er i forbindelse med blandingstanken 28, til processering af den opvarmede gipsopslemning fra blandingstanken 28, hvilken autoklave 38 trykker og opvarmer gipsopslemningen, hvorved gipsopslemningen kalcineres til opnåelse af alfa-type-gips og damp, hvilken gips anvendes til produktion af gipsplader, hvor der opnås en energibesparelse ved anvendelse af en opvarmet gipsopslemning i autoklaven 38.

2. System til produktion af alfa-type-gips på pladefabrikker ifølge krav 1, hvor kondensattemperaturen ligger inden for det omtrentlige interval 76 °C til 88 °C;
og kondensatet fra kondensatoren 26 blandes med en kombination af rå gips og fugt i et 50:50-vægtforhold til frembringelse af gipsopslemningen med en temperatur inden for det omtrentlige interval 60 °C til 72 °C;
en pumpe 34 til fremføring af en portion af gipsopslemningen fra blandingstanken 28 til kondensatoren 26, hvor gipsopslemningen anvendes som kølemiddel til frembringelse af kondensat;

og gipsopslemningen kalcineres til opnåelse af en alfa-type-gips og damp, hvor alfa-type-gipsen anvendes til produktion af gipsplader, og hvor dampen, der dannes fra produktionen af alfa-type-gipsen fremføres til blandingstanken til yderligere forøgelse af temperaturen i opslemningen til det omtrentlige interval 76 °C til 88 °C.

3. System ifølge krav 1, der yderliger omfatter en pumpe 34 til fremføring af en portion af gipsopslemningen fra blandingstanken 28 til kondensatoren 26, hvor gipsopslemningen anvendes som kølemiddel til frembringelse af kondensat.

4. System ifølge krav 1 hvor damp, der udluftes fra produktionen af alfa-type-gipsen, fremføres til blandingstanken 28 til yderligere forøgelse af temperaturen i opslemningen.

5. System ifølge krav 1 hvor kalcineringer i autoklaven 38 frembringer en alfa-type-gips.

6. System ifølge krav 1, hvor tilsætning af opvarmet kondensat til blandingstanken 28 frembringer en gipsopslemning med en temperatur inden for det omtrentlige interval 60 °C til 72 °C.

7. System ifølge krav 1, hvor befugtet gips og opvarmet kondensat fremføres til blandingstanken 28 i et 50:50-vægtforhold.

8. Fremgangsmåde til produktion af alfa-type-gips, der produceres ved anvendelse af systemet ifølge krav 1, der omfatter:
tørring af gipsbaserede byggematerialer til fjernelse af overskydende fugt og opsamling af den overskydende fugt som damp;
kondensering af den opsamlede damp til frembringelse af et opvarmet kondensat;
blanding af det opvarmede kondensat med rå gips til

frembringelse af en opvarmet gipsopslemning;
kalcinering af den opvarmede gipsopslemning til opnåelse af alfa-gips og damp.

9. Fremgangsmåde ifølge krav 8, der indbefatter det yderligere trin kondensering af dampen, der dannes fra kalcineringstrinet, til frembringelse af et opvarmet kondensat og blanding af det opvarmede kondensat med den rå gips til yderligere forøgelse af temperaturen af gipsopslemningen.

DRAWINGS

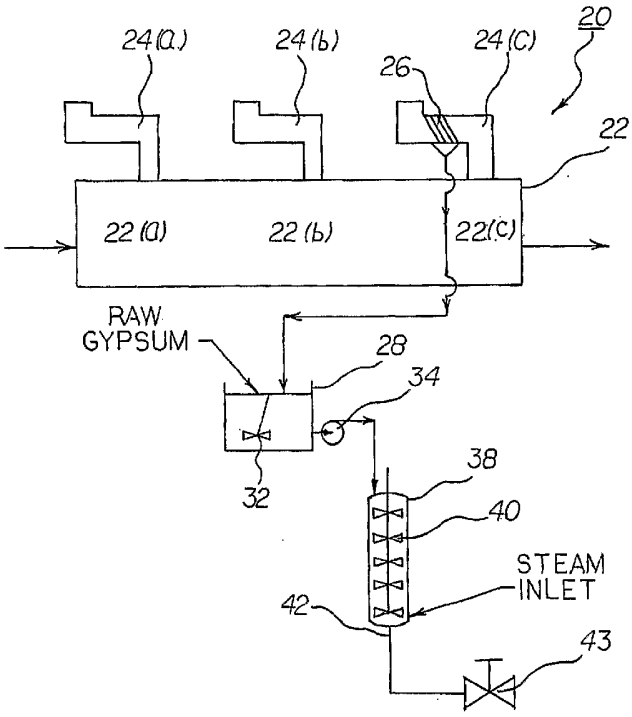


FIG. 1

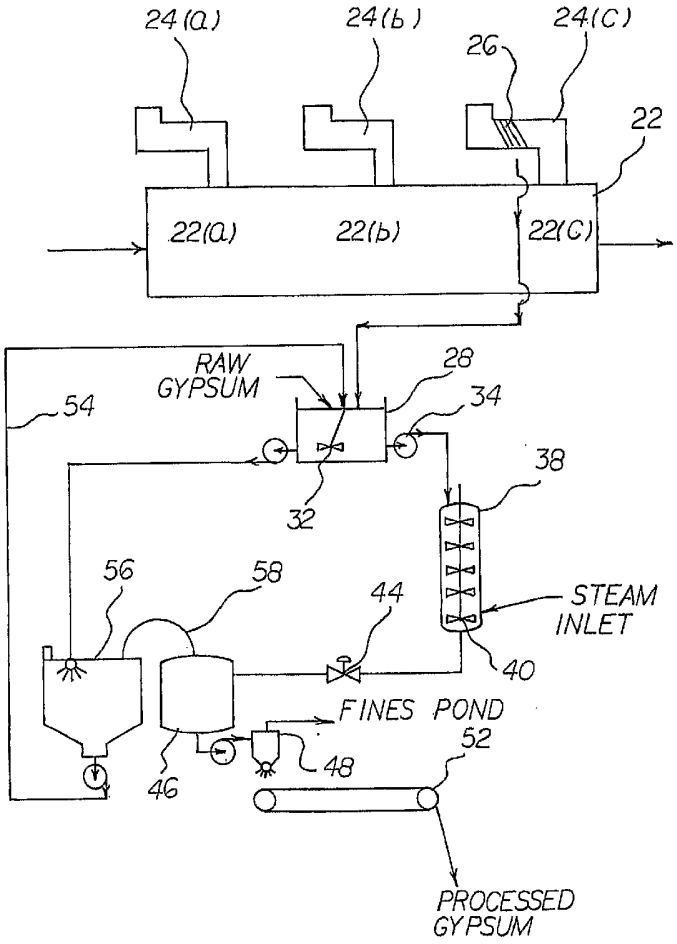

24(a)
24(b)
24(c)
26
22
22(a)
22(b)
22(c)
RAW
GYPSUM
28
34
54
38
32
56
58
44
STEAM
INLET
40
FINES POND
52
48
46
PROCESSED
GYPSUM

FIG. 2

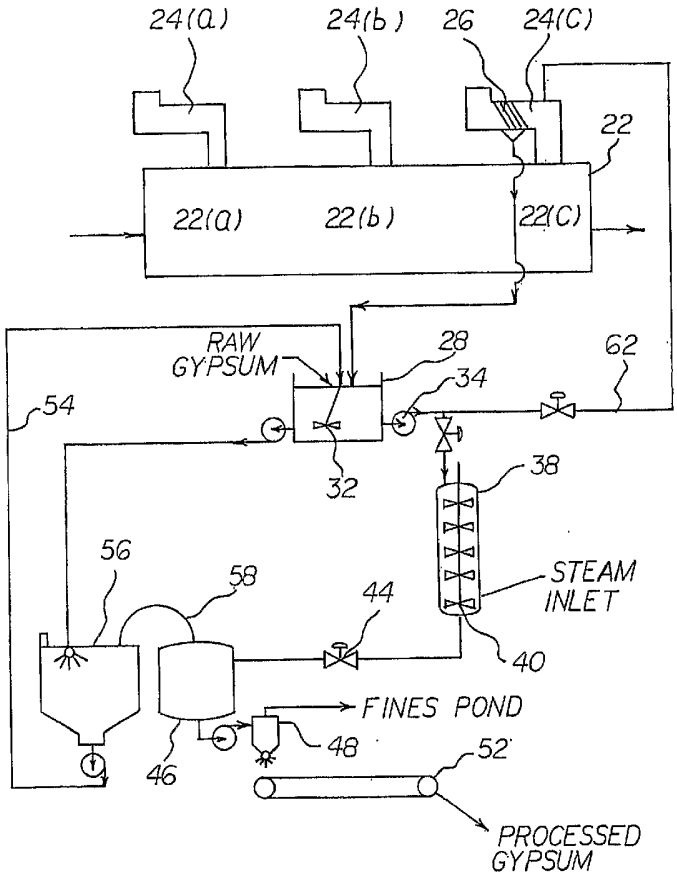

24(a)
24(b)
26
24(C)
22
22(a)
22(b)
22(C)
RAW GYPSUM
28
62
34
54
32
38
56
58
44
STEAM INLET
40
FINES POND
48
52
46
PROCESSED GYPSUM

FIG. 3